



## → Combating counterfeit products with RFID

Dr. Florian Michahelles

[fmichahelles@ethz.ch](mailto:fmichahelles@ethz.ch)

Department of Management, Technology and Economics,  
ETH Zurich, Switzerland

Auto-ID Labs and M-Lab



## Fakes often have to cross national borders...



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Page 2





...and there are many creative ways...



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...which are hard to detect...



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Page 4





...and require experience.



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Page 5





# Physical inspections triggered by experience-based risk analysis



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Page 6

## HEAD

- 1) Company
- 2) Nationality
- 3) Flight Number
- 4) Date of departure (is not always the arrival date !)
- 5) point of lading
- 6) point of unlading

 ICAO Annex 9 Appendix 2 OACI Anexo 9 Apéndice 2		<b>CARGO MANIFEST</b> <b>MANIFIESTO DE CARGA</b>  Owner or operator <i>Propietario o explotador</i>  KLM Royal Dutch Airlines <i>KLM Compañía Real Holandesa de Aviación</i>  Trade Register Amsterdam no. 14286 <i>Registro Mercantil Amsterdam no. 14286</i>		3772  OO 0154 16SEP  OO 0154 16SEP			
Marks of nationality and registration <i>Matricula y nacionalidad</i> Point of loading (place) <i>Punto de embarque (lugar)</i> Air Waybill no. <i>Número de conocimiento</i>		KLM  AMS	Flight no. KL8101 <i>Vuelo no.</i> Point of unloading (place) <i>Punto de desembarque (lugar)</i> For use by owner/operator only <i>Para uso exclusivo del propietario/explotador</i>		Date 16SEP 2004 <i>Fecha</i>  BRU  6		
Airline prefix <i>Prefijo Lin. A.</i>	Serial no. <i>No. serial</i>	No. of pckgs <i>No. de bultos</i>	Nature of goods <i>Naturaleza de las mercancías</i>	Spec. CGO <i>CGA esp.</i>	Gross weight <i>Peso bruto kgs</i>	Origin/destination <i>Origen/destinación</i>	For official use only <i>Sólo para uso oficial</i>



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25 April 2007  
Page 7

SHIPPER		AWB NUMBER	
705 BRU 01408956		705-01408956	
SHIPPER'S NAME: AGENTIN MAC HONGKONG AS AGENTS ONLY.		SHIPPER'S ACCOUNT NUMBER: 705-01408956	
CONSIGNEE: BELTRON INTERN CE NO. PARAGUAY TEL 595-61-60978		Not negotiable Air Waybill	
AIRPORT OF DEPARTURE: BRU		Issued by: L. A. P. Oliva 455/467	
ROUTING: ASU		ACUNCION PARAGUAY	
SUPPLEMENTARY INFORMATION: A S U N C I O N P 7801/171193		Copies 1, 2 and 3 of this Air Waybill are accepted in apparent good order and condition (except as noted) for carriage SUBJECT TO THE CONDITIONS OF CONTRACT ON THE REVERSE HEREOF. THE SHIPPER'S ATTENTION IS DRAWN TO THE NOTICE CONCERNING CARRIAGE LIMITATION OF LIABILITY. Shipper may increase such limitation of liability by declaring a higher value for carriage and paying a supplemental charge if required.	
NUMBER OF PIECES: 15		DESCRIPTION OF THE GOODS: PLASTIC DISCS	
GROSS WEIGHT: 33180		DIMENSIONS: 15 CARTONS, DIMS: 42X23X30CMS(14X) 41X48X22CMS(1X)	
WAY OF PAYMENT: 33180		SIGNATURE: [Signature]	
DATE: 16/11/93		EXP: 16/11/93	



# Physical inspections triggered by experience-based risk analysis



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25 April 2007  
Page 8

**AWB NUMBER**

705 BRU 01408956

**SHIPPER**

AGENTS: HONGKONG AS AGENTS ONLY.

**CONSIGNEE**

BELTRON INTERNACIONAL S.A. PARAGUAY TEL 595-61-60978

**AIRPORT OF DEPARTURE**

ASU

**ROUTING**

ASU

**SUPPLEMENTARY INFORMATION**

PLEASE NOTIFY CG NEE ARRIVAL 978

**DESCRIPTION OF THE GOODS**

PLASTIC DISCS  
15 CARTONS, DIMS:  
42X23X30CMS (14X)  
41X48X22CMS (1X)

**DIMENSIONS**

42X23X30CMS (14X)  
41X48X22CMS (1X)

**NUMBER OF PIECES**

15

**GROSS WEIGHT**

33180

**WAY OF PAYMENT**

GTC:177-BEC

**DATE**

16/11/93

**SIGNATURE**

BRUCARGO

705-01408956



# Physical inspections triggered by experience-based risk analysis



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Page 9

082\_2009 7324

Shipper's Name and Address  
**ELHADJ SANOUSSY**  
**DIAKITE**  
TEL/ 011 54 77 67 CONAKRY

Shipper's Account Number

Not Negotiable  
**Air Waybill**  
Issued by  
**DAT TRADING AS**  
**ON BRUSSELS AIRLINES**

Copies 1, 2 and 3 of this Air Waybill are originals and have the same validity

Consignee's Name and Address  
**REP. DE GUINEE**  
**ORGANIZACOES SOCOSOL COMERCIAL**  
**COMERCIO GERAL IMPORTACAO EXPORTACAO LDA**  
**RUA CINE AFRICA S/N Bº MOJI - TA - HENDA**  
**CAZENGA LUANDA CONTRIBUINTE Nº 0159396/00-0**  
TEL/ 092 31 51 30 092 42 01 97 A N G O L A

Consignee's Account Number

Issuing Office's Agent Name and City

Accounting Information

**AIRPORT OF DEPARTURE : CONAKRY**

**CONAKRY - GKY**

To By First Carrier To By Second Carrier To By Third Carrier To By Fourth Carrier To By Fifth Carrier To By Sixth Carrier To By Seventh Carrier To By Eighth Carrier To By Ninth Carrier To By Tenth Carrier

Declared Value for Carriage  
**NVD**

Declared Value for Customs  
**NCV**

**FINAL DESTINATION: LUANDA ....**

**Routing: CONAKRY - BRUSSEL - LUANDA ...**

**360 KG OF MEDICINS**

**PREPAID...**

2286.00

2286.00

2950.15

2500T 2003 GKY / TRANSCO S.A. N. MOUNTAGHA

082\_2009 7324

COPY 5 (EXTRA COPY)



# Physical inspections triggered by experience-based risk analysis



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Page 10

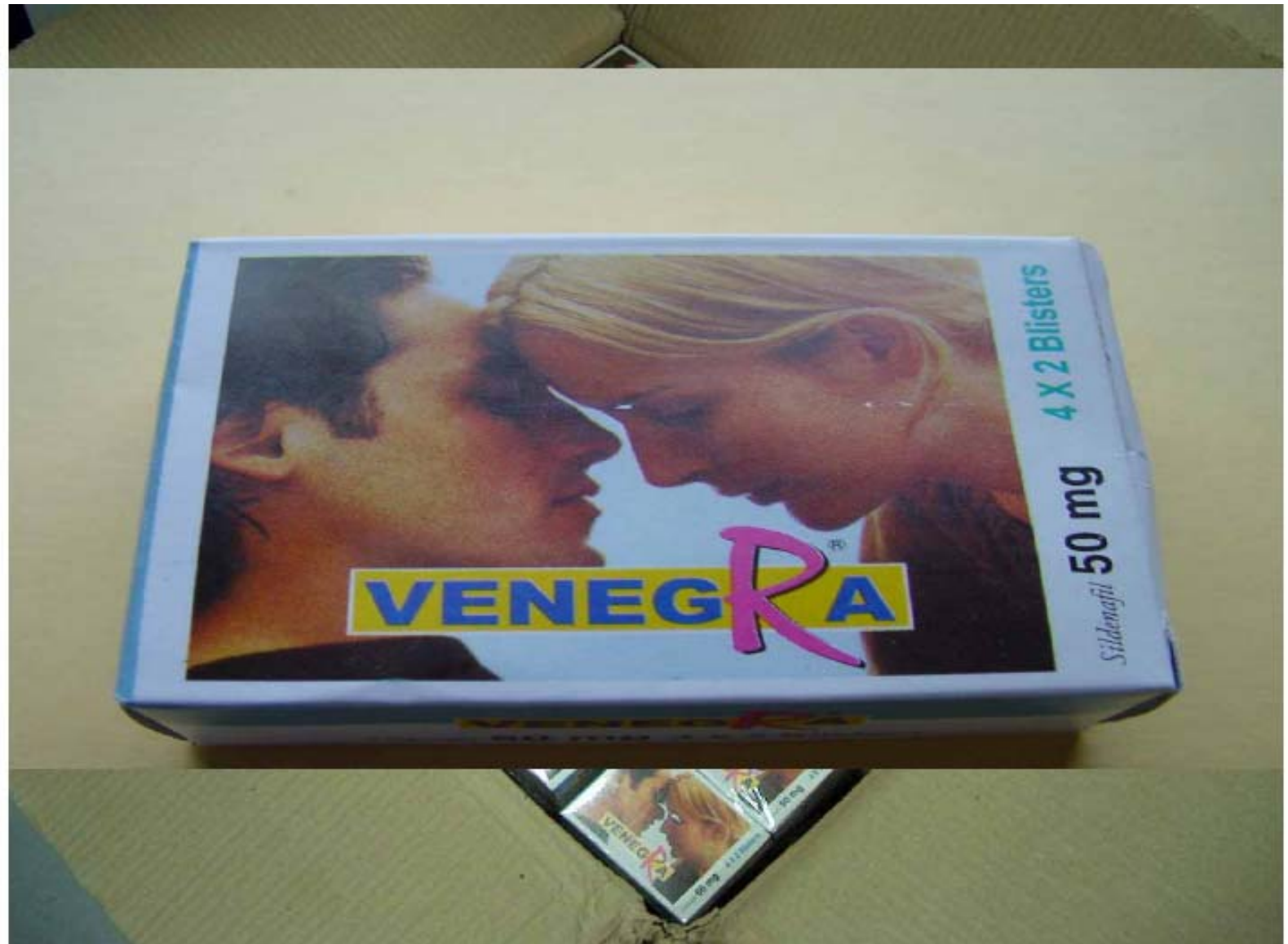




# Physical inspections triggered by experience-based risk analysis



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Page 11

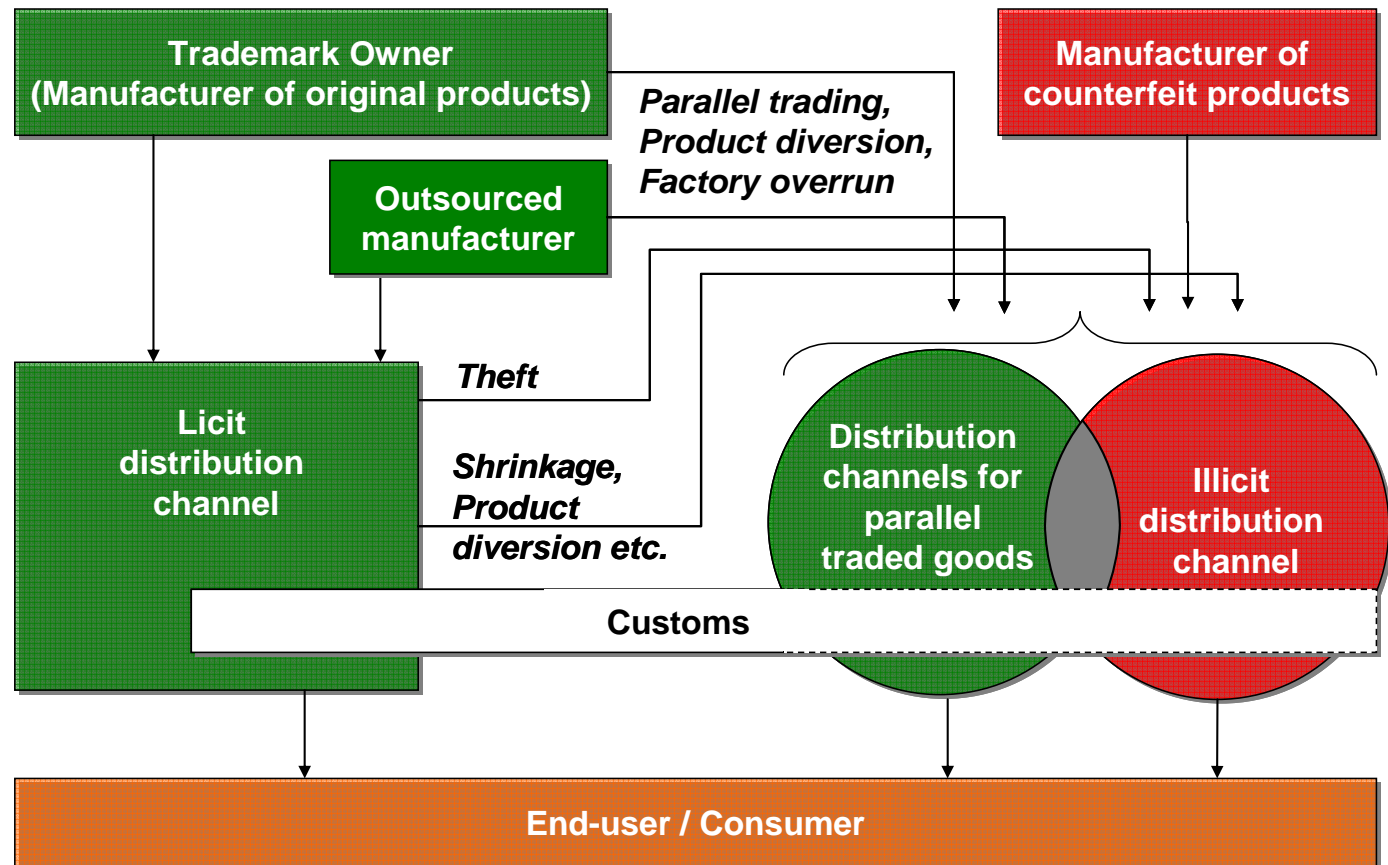




# Distribution Channels for Counterfeit Products



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Page 12



→ Flow of goods



# Overall extent of counterfeiting

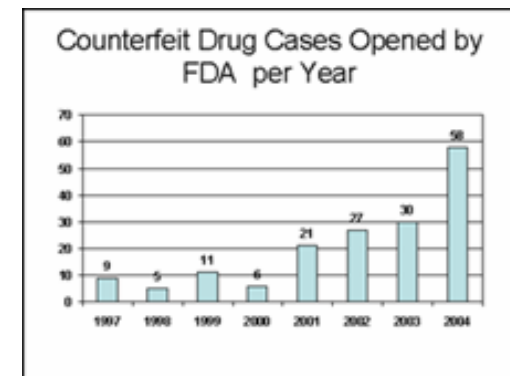


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Page 13

- By definition, the problem is hidden and difficult to measure
- ICC estimated the overall cost of counterfeiting in the world about 5-7% of world trade (International Chamber of Commerce, 1997)
  - Often quoted but very unreliable number
- OECD has recent, more accurate estimate that counterfeiting and piracy is likely to account for less than USD 176 billion, or 2% of international trade
  - Result is extrapolated from detection statistics



[ICC]



[Food and Drug Administration]



# Drivers and enablers of illicit trade



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Page 14

**Advances in  
manufacturing  
technology**

**Increased  
international trade**

**Growing  
professionalism**

**Low political will to help:  
Anti-counterfeiting has  
low overall priority  
Parallel trade is legal**

**Internet as distribution  
channel (Lacking  
regulations, no liability  
of service providers)**

**Low risks and high  
returns (*Law of  
greed*)**

**Emerging markets  
(China)**

***Illicit trade is mostly beyond the control of  
individual companies***



# Illicit trade in... IT Industry



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Page 15

- Software industry suffers from product piracy
- Example cases of product counterfeiting
  - Re-labeling of 233 MHz Intel Pentium II processors to 266 MHz (1998)
  - Counterfeit electronic devices such as cell phones or MP3-players can contain fake or modified chips
  - Millions of counterfeit mobile phone batteries per year (e.g. Nokia)
  - Replacing branded parts (e.g. memory chips) of computer packages by non-branded ones





# Illicit trade in... Automotive Industry



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Page 16



- Profit margins very slim, aftermarket
- Expensive parts that are easy to copy and frequently used are most often targeted by counterfeiters
  - filters, spark plugs, headlamps, bumpers, side mirrors, brake pads
- Counterfeits manufactured in e.g. in Asia, East-Europe
- Internet, free garages, non-certified retailers are most important distribution channel of counterfeit parts



# Illicit trade in... Pharmaceutical Industry



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Page 17

- Production of counterfeit drugs is relatively easy:
  - Technology is easily available, global distribution, valuable brands
- Distribution through Internet or by injection to licit distribution channel
- Re-packaging can open door for counterfeits
- Parallel trade and diversion
- Patient safety is companies priority





# Illicit trade in... Aerospace Industry



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Page 18

- Counterfeit airplane spare parts endanger passenger safety
- Almost all parts in airplane hold certificate of authenticity and a lifecycle report
- Problem mechanism
  - Refurbished parts are often reused in different aircrafts
  - Counterfeits are sold as refurbished parts
  - Complex spare parts can contain counterfeit parts





# Illicit trade in... Luxury Goods Industry



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Page 19

- Luxury brands communicate exclusiveness, higher quality
- Problem is counterfeit products from low to high quality
- Most counterfeit luxury products are of low-quality, sold outside authorized distribution channels
- Consumer survey shows that
  - almost as many consumers buy a counterfeit product than an original one
  - those who have bought counterfeits are actually more likely buy also original products





# Illicit trade in... Consumer Goods and Retail Industry



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Page 20

- Counterfeit consumer goods include textiles, sportswear, food, furniture etc.
- In some cases counterfeit products can even be found in retail stores
- Counterfeit products are mixed with parallel traded goods





# Impact of illicit trade



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Page 21

## Impact on companies

- **Counterfeiting is theft from the brand owner**
- **Direct impact contains**
  - Counterfeits substitute (partly) original products
  - Liability claims such as warranty
  - Increased workload for monitoring, preventing, and intervening
- **Indirect impact:**
  - Decreased brand value (e.g., exclusiveness) and goodwill
  - Risk factor from liability
  - Decrease return on investment (ROI) of marketing and RnD

## Impact of illicit trade on consumers and societies

- **Impact on consumers**
  - Counterfeit product can be perceived as *good bargain* by consumers
  - Safety and health of consumers can be endangered
- **Impact on societies**
  - IPR infringements discourage innovation decreasing economic growth
  - Counterfeiters do not pay taxes and are not model employers



# What does that mean for anti-counterfeiting?



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Page 22

- ➔ Counterfeiting and illicit trade form serious and variable problems among different industries
- ➔ Quantity of counterfeit products is increasing and quality is improving
- ➔ Technical anti-counterfeiting system should increase the risk profile of counterfeit players
- ➔ Core of the solution is product authentication, it depends on the case how and by whom this should be done



# Agenda



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Page 23

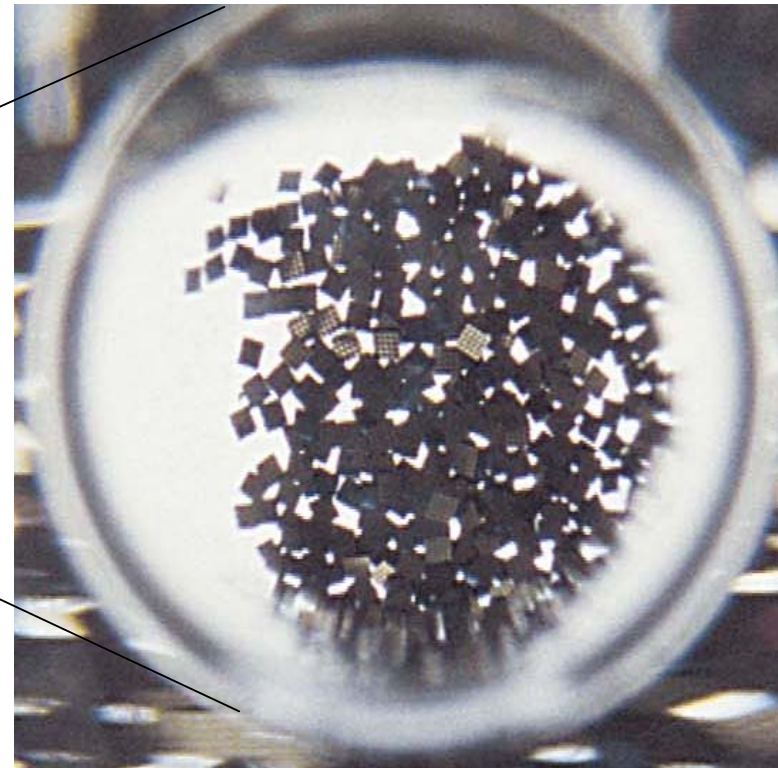
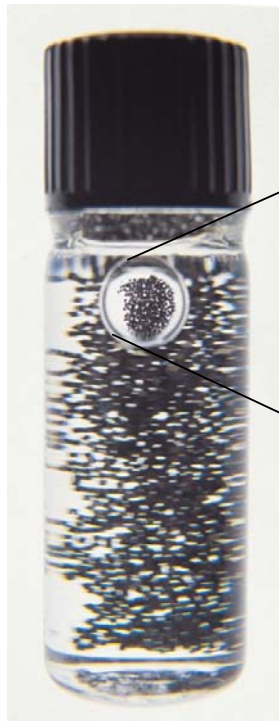
- The Problem of Counterfeits
- Promises of RFID technology
- Towards an Anti-Counterfeiting Solution
- Current Projects
- Outlokk & Implications



## Low cost minicomputers ...



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Page 24

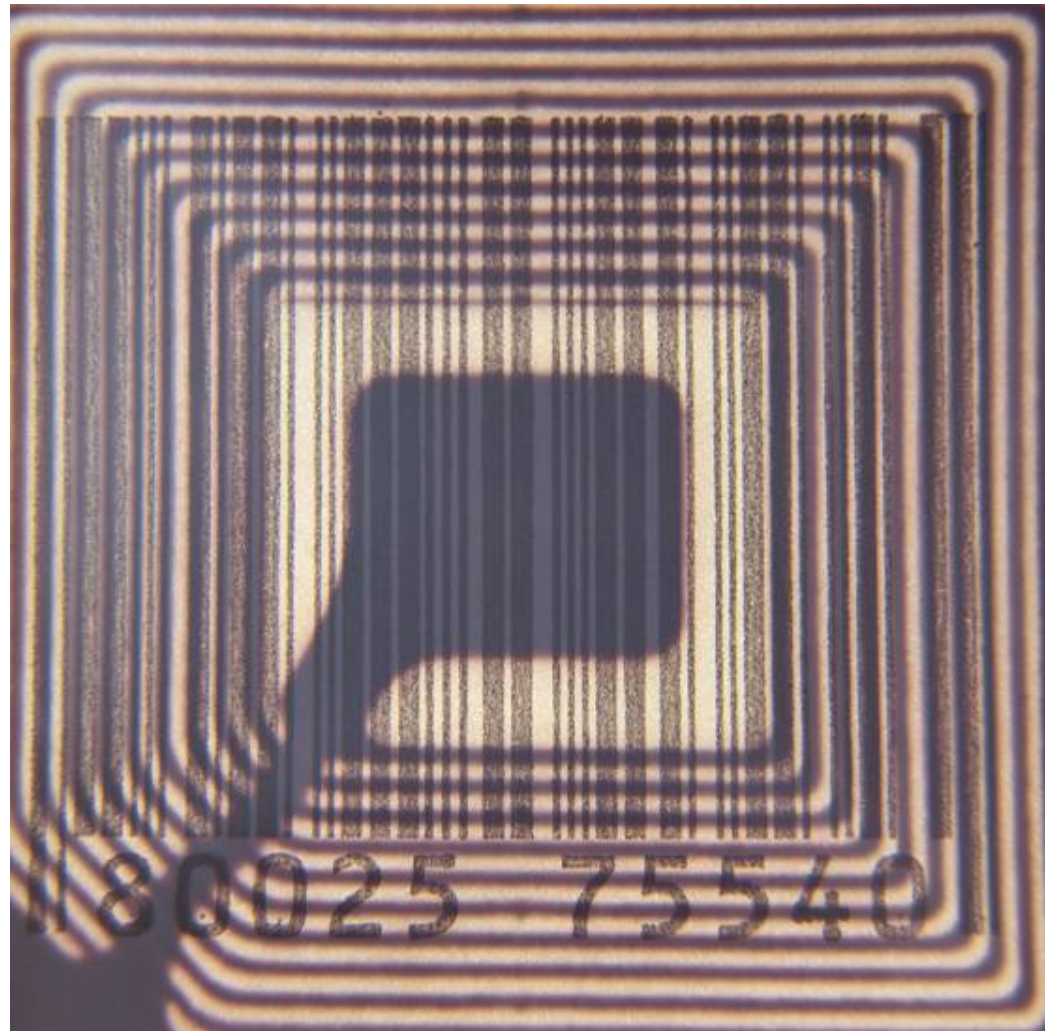




... with mobile communication capabilities ...



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Page 25

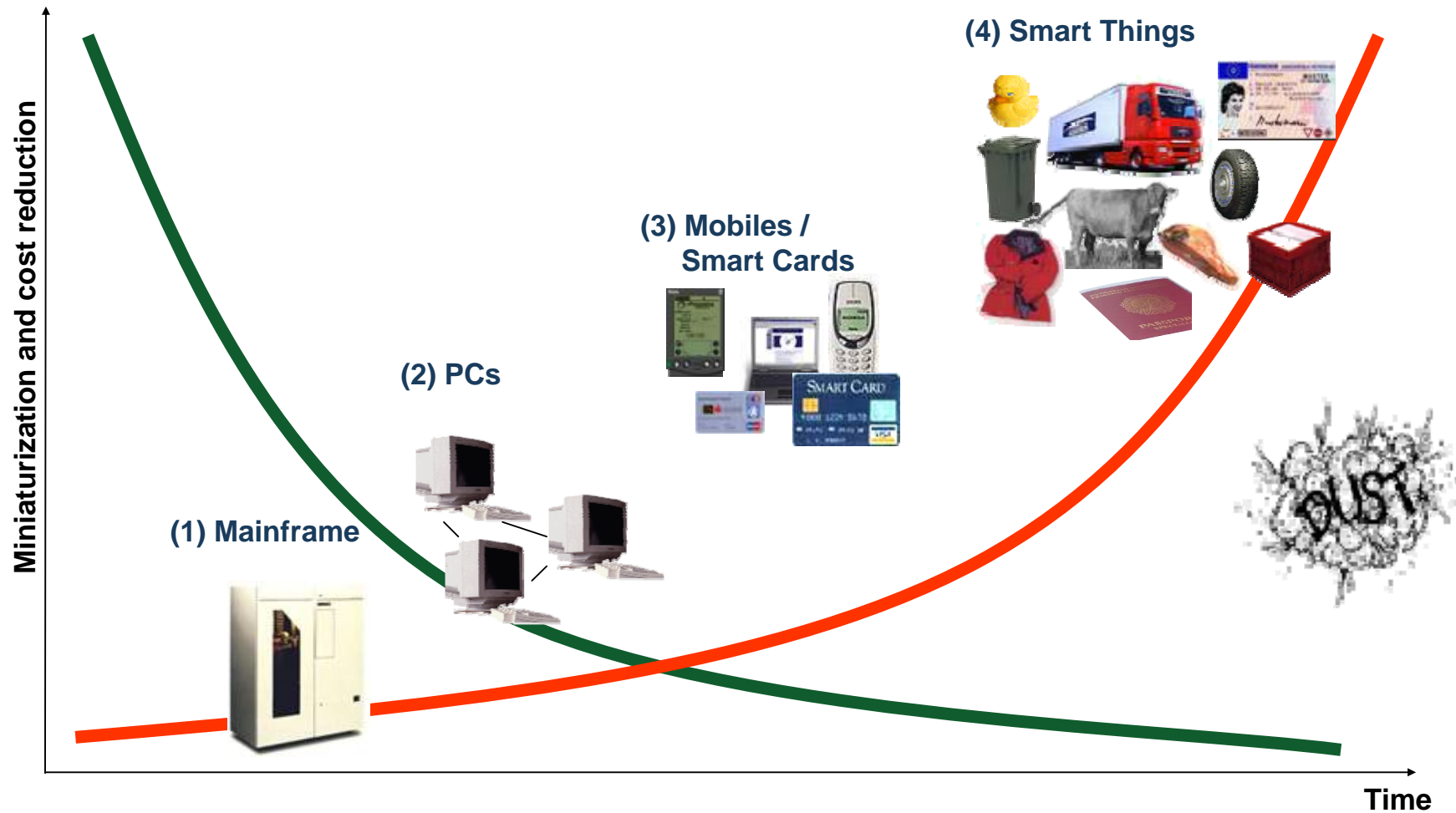




# Recent advances in miniaturization, ...



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Page 26



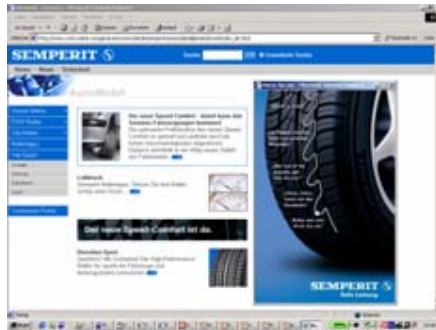


... finally help to link real world things at low cost to homepage(s),...



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Page 27

## Virtual world



## Real world





# Agenda



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Page 28

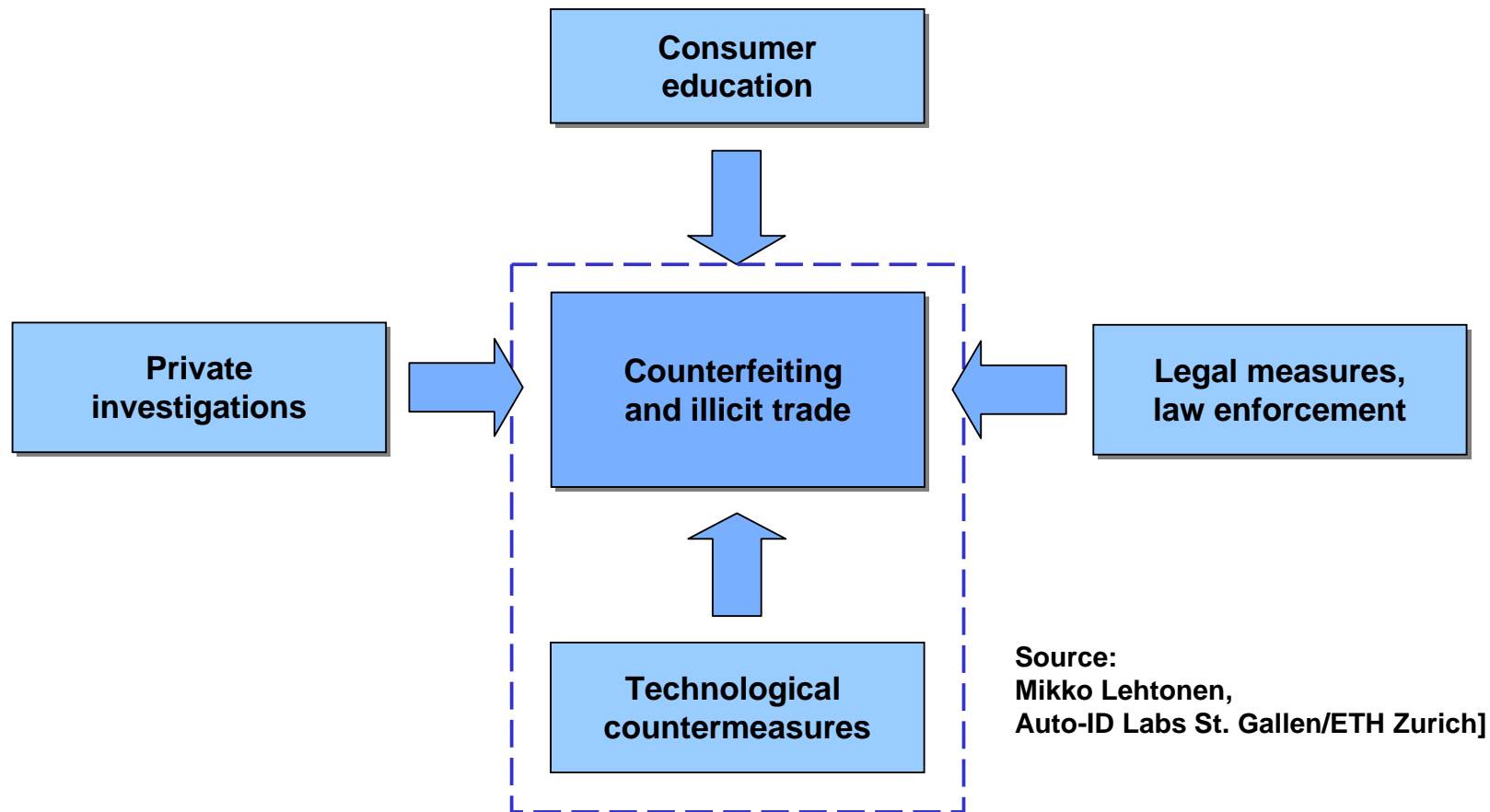
- The Problem of Counterfeits
- Promises of RFID technology
- **Towards an Anti-Counterfeiting Solution**
- Current Projects
- Outlook & Implications



# Towards an Anti-Counterfeiting Solution



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Page 29



Source:  
Mikko Lehtonen,  
Auto-ID Labs St. Gallen/ETH Zurich]

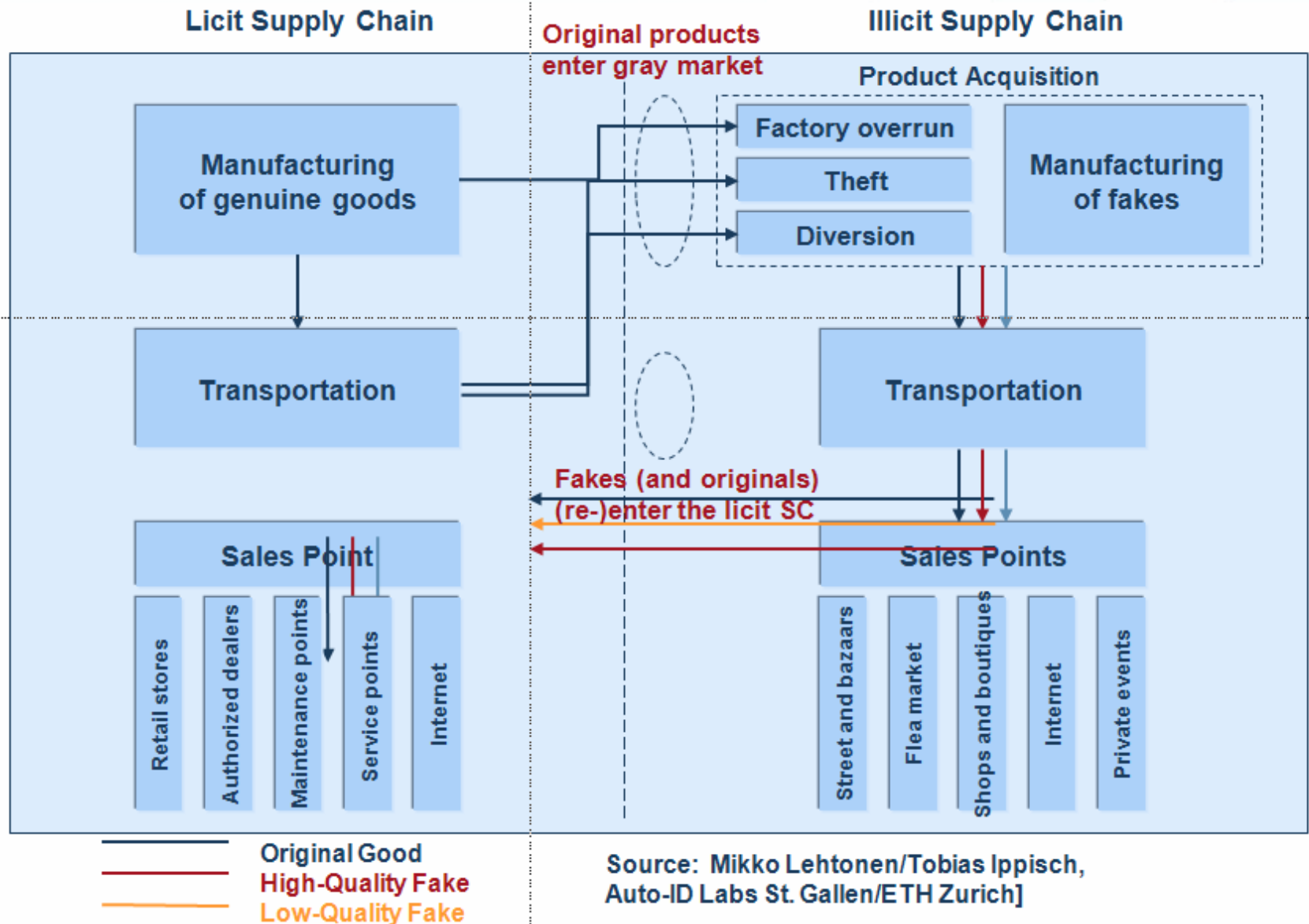
- Our approach: Authentication of products
  - Distinguish genuine from fake goods
  - Easy-of-use, broaden the user base
  - Long-lasting
  - Reliability



# Mechanisms of illicit trade



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Page 30

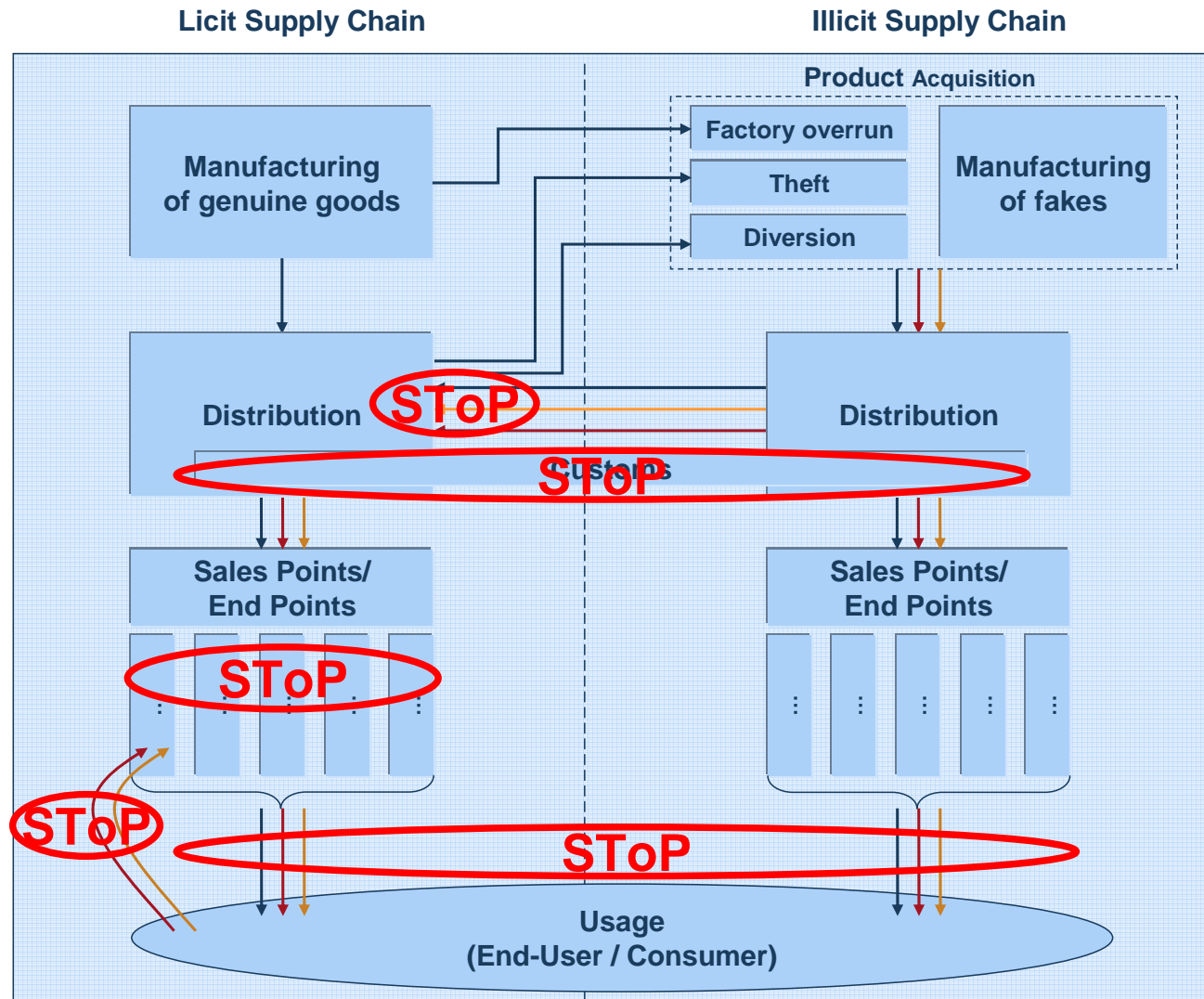




# Use Cases of Product Authentication



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Page 31





# Use Cases of Product Authentication



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Page 32

- Product authentication is a tool that can be used to find counterfeit products
- This tool can be used to achieve following goals
  1. Prevent counterfeits from entering the licit distribution channel
  2. Help customs to detect infringing products
  3. Keep sales-points and end-points clean from counterfeits
  4. Enable authentication of products that are in use
  5. Enable after sales services to authenticate products



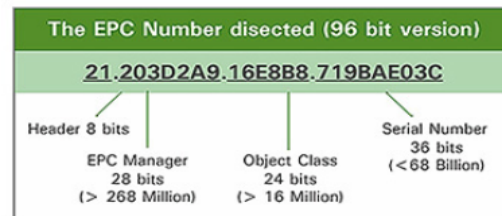
# Principle anti-counterfeiting solutions under study



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Page 33

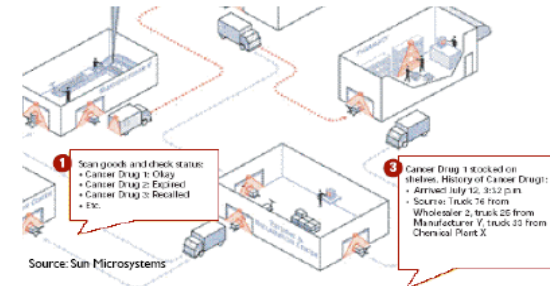


## Unique serial numbering



Source: Auto-ID Lab

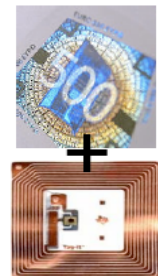
## Track and trace based plausibility checks



Source: Auto-ID Lab

## Product verification with RFID

- Combination of measures
- Integrated into product
- Use physical properties



## Object-specific features



# Unique serial numbers on item or case level



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Page 34

- Unique serial numbers stored on RFID transponders
  - Lowest cost
    - per feature
    - per check
  - Reasonable level of security
  - Reasonable complexity
  - Foundation for further solutions
  - Ready-to-implement solutions are available

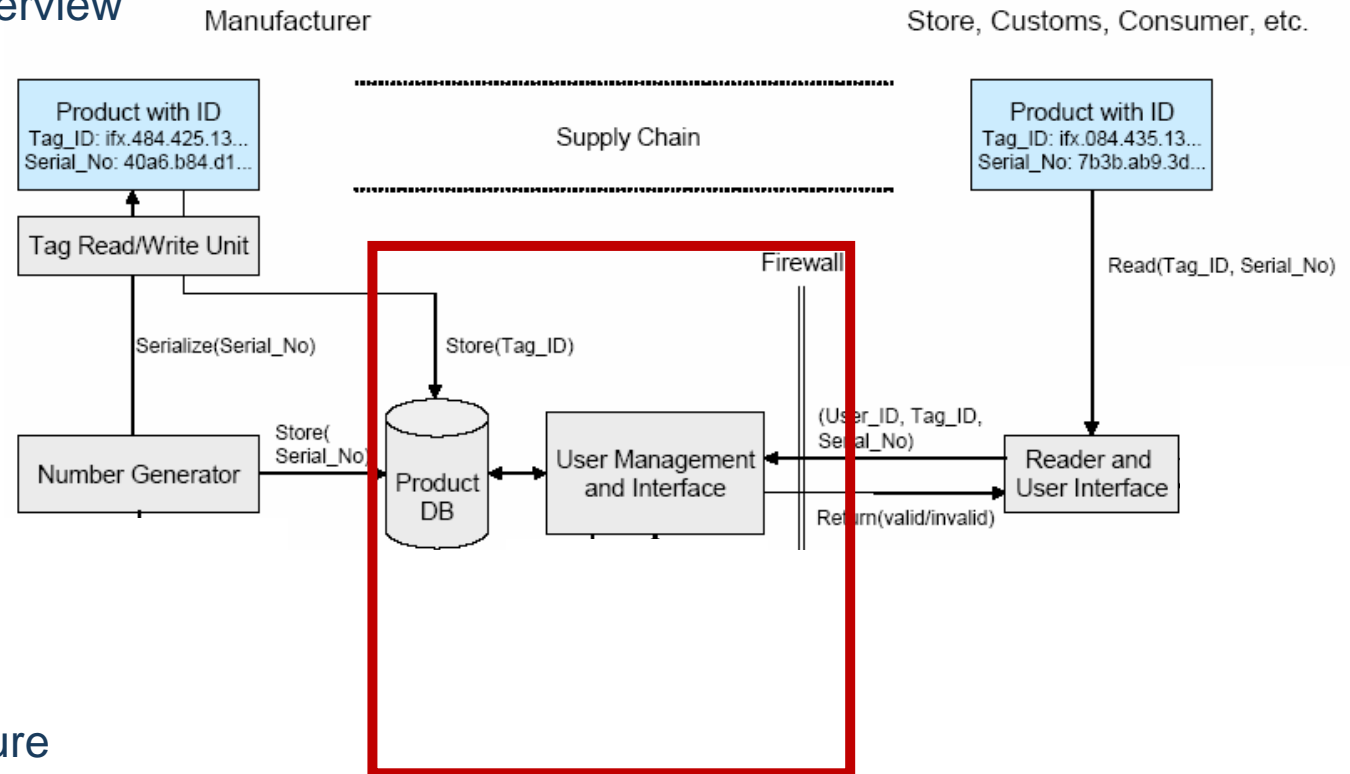


# Unique serial numbers stored on RFID transponders



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Page 35

## Infrastructure overview



- Lowest cost
  - per feature
  - per check
- Reasonable level of security
- Reasonable complexity
- Ready-to-implement solutions are available
- Foundation for further solutions



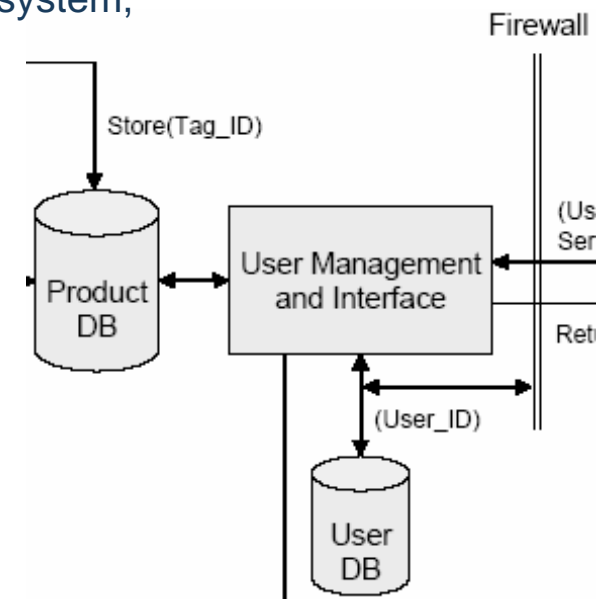
# User management



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Page 36

- Opening the system for a larger number of users increases its usability
- However this allows for attacks: Problems may arise if illicit actors retrieve valid numbers.
- Customs and supply chain partners
  - enabled to conduct bulk checks
  - access control
- Public access
  - restricted number of requests per time → avoid denial of service-attack
  - authentication of the requesting party :
    - User registration.
    - No registration, but answer provided by email
    - Using authentication of the requesting system, e.g. caller ID from cell phone
  - Reward the check, and place it as service

→ Approaches not restricted to RFID



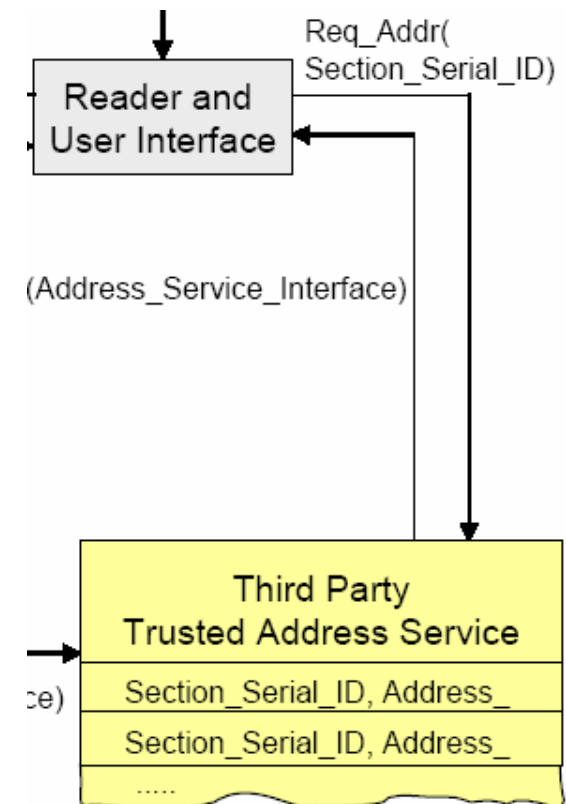


# Using trusted address services



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Page 37

- The lean "hard wired" solution is not feasible in m to n environment
- An external, trusted address service is necessary if
  - The web page is not a desired entry point
  - Test equipment is not under control of the brand owner, or
  - Many brand owners use the same application and numerous service addresses
- A standardized directory service, e.g. ONS proposed by EPCnetwork, would be required
- Link address is crucial for security
  - Only for registered manufacturers
  - We suggest an additional manufacturer registration process





# Plausibility checks based on track and trace



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Page 38

- Record of past and possible future owners or locations
- Illicit trade can be detected using business logic
- Promising for highly regulated industries
- Provides numerous additional benefits

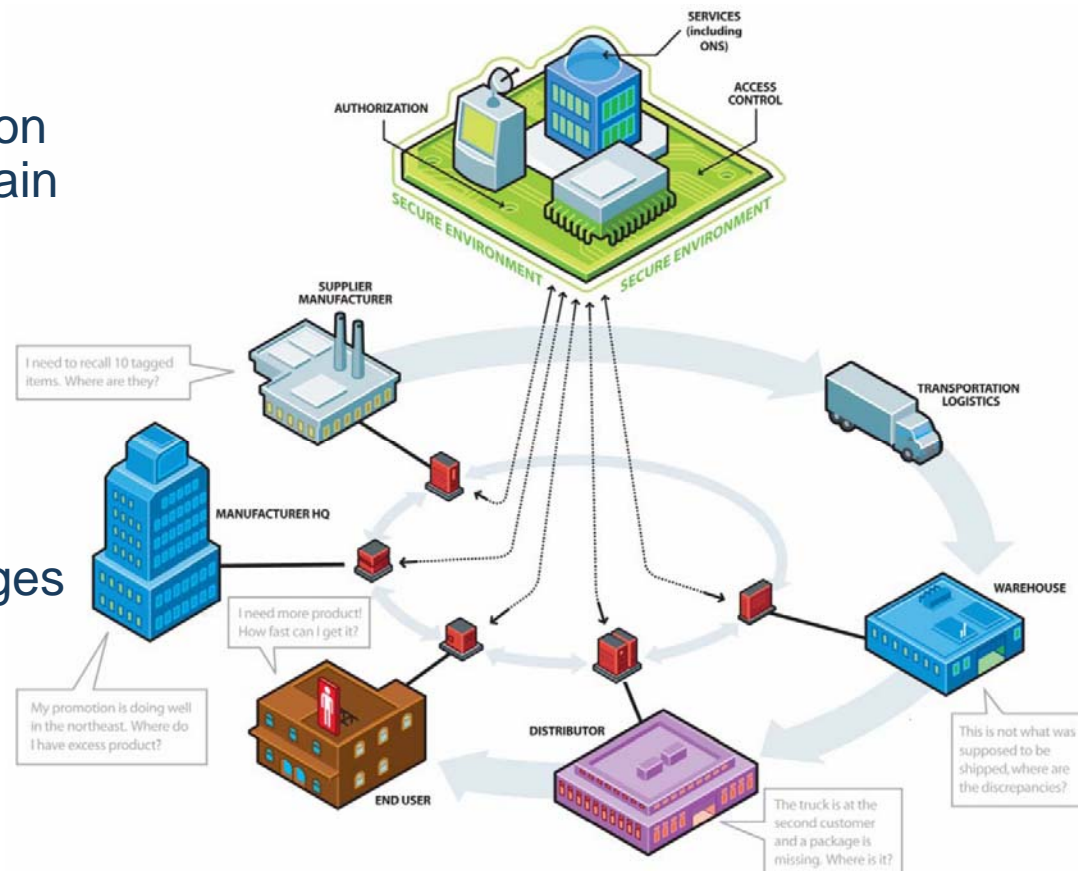
- Requires the cooperation of numerous supply chain organizations:

## ➔ Technical challenges

- Access rights
- Business logic
- Data exchange formats
- Standardization

## ➔ Organizational challenges

- Different interests





# Track & Trace



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Page 39

- Pros:
  - Cloned tags are easier to detect
  - “Ok” to implement in a simple supply chain
- Cons:
  - Requires network access to authenticate tag/product
  - Gets complex in non-predetermined supply chains (access rights, ...)
  - Requires standardized network infrastructure
  - Business partners might not be willing to share these data
  - Tag-cloning not completely eliminated
- Our recommendation in the context of anti-counterfeiting
  - Important approach for the pharmaceutical industry
  - Only powerful if all partners use it
  - Don’t wait for ready solutions, use the unique serial approach instead



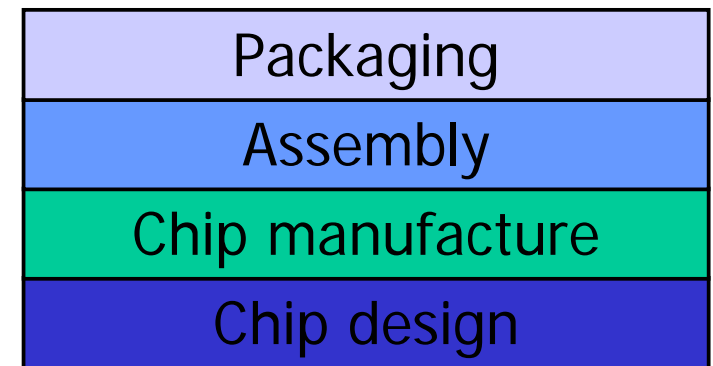
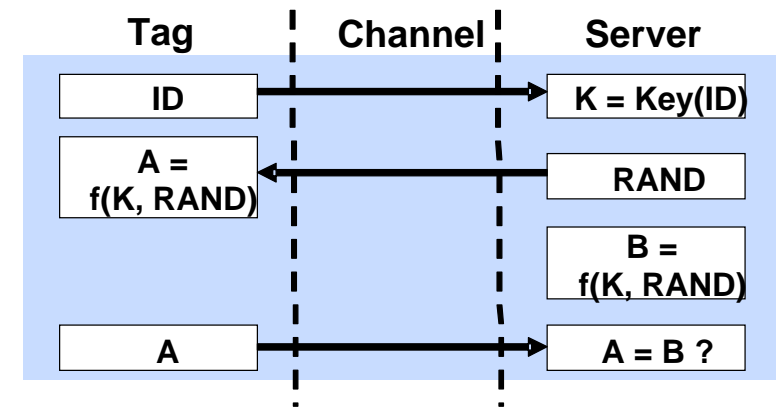


# Crypto tags



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Page 40

- **Pros:**
  - Cloning attacks become unfeasible
- **Cons:**
  - Tags are still expensive and not standardized
  - Extra time required for challenge/response protocol
  - Read range is limited
  - How to deal with recycled tags?
- Will become more important in the future
- Only for very expensive and security relevant parts, e.g. in the aviation industry



RFID cost drivers

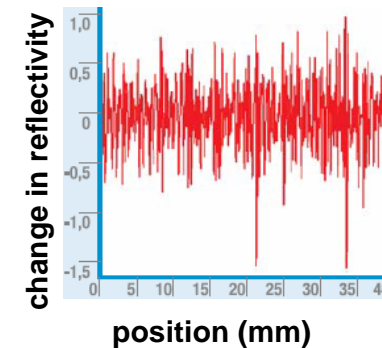
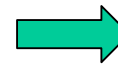
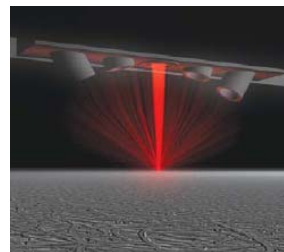


# Object Specific Security



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Page 41

- The previous approaches concentrate on preventing cloning attacks
- RFID is a tagging technology
  - It is still the transponder you authenticate
  - Care must be taken to that a genuine tag cannot be removed and reapplied to an illicit product
- Goal: integrate RFID-tag into the product
  - incorporate RFID tags during manufacturing
  - “passport approach”: store object specific features
    - weight
    - shape
    - surface



Source: Protexxion, Bayer Technologies

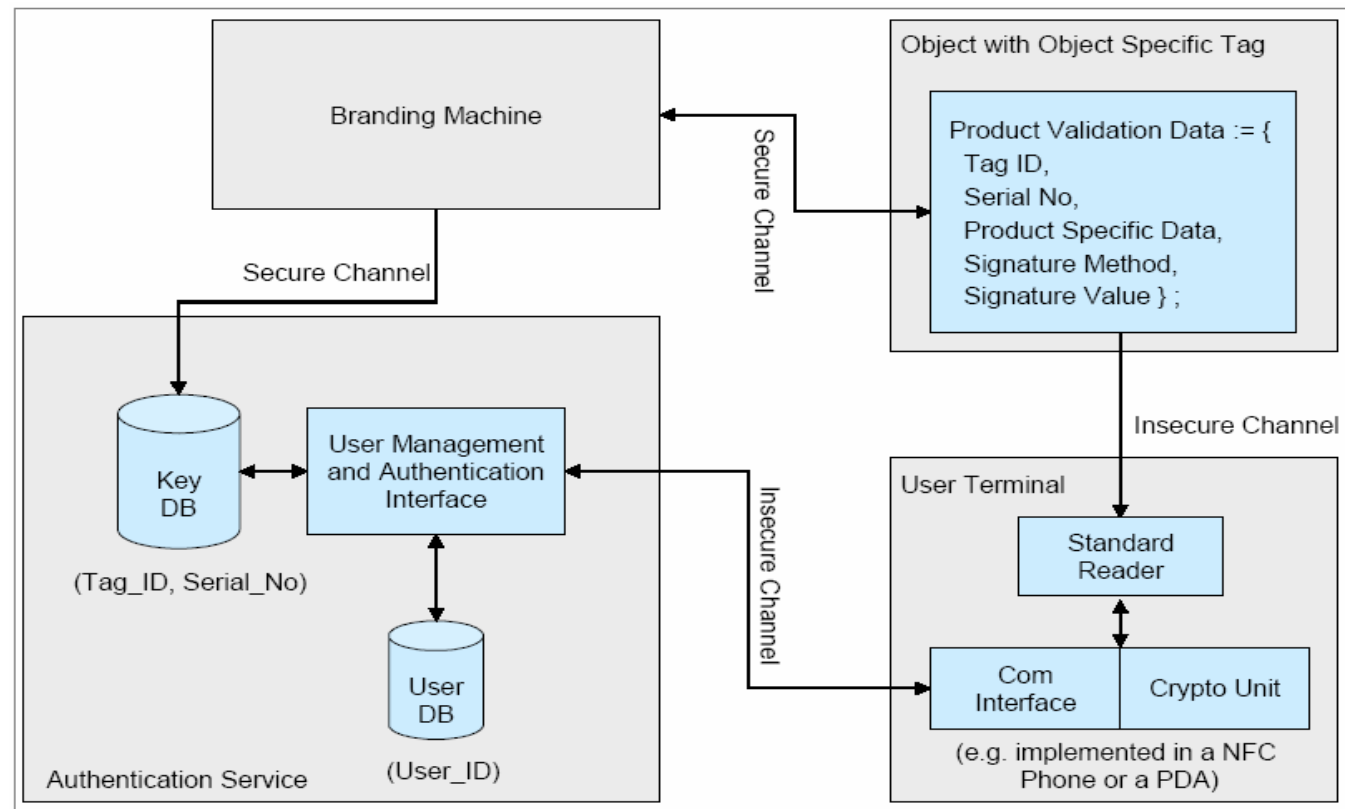


# Object Specific Security



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Page 42

- Approach: tag-product integrity by storing a “fingerprint” on the tag

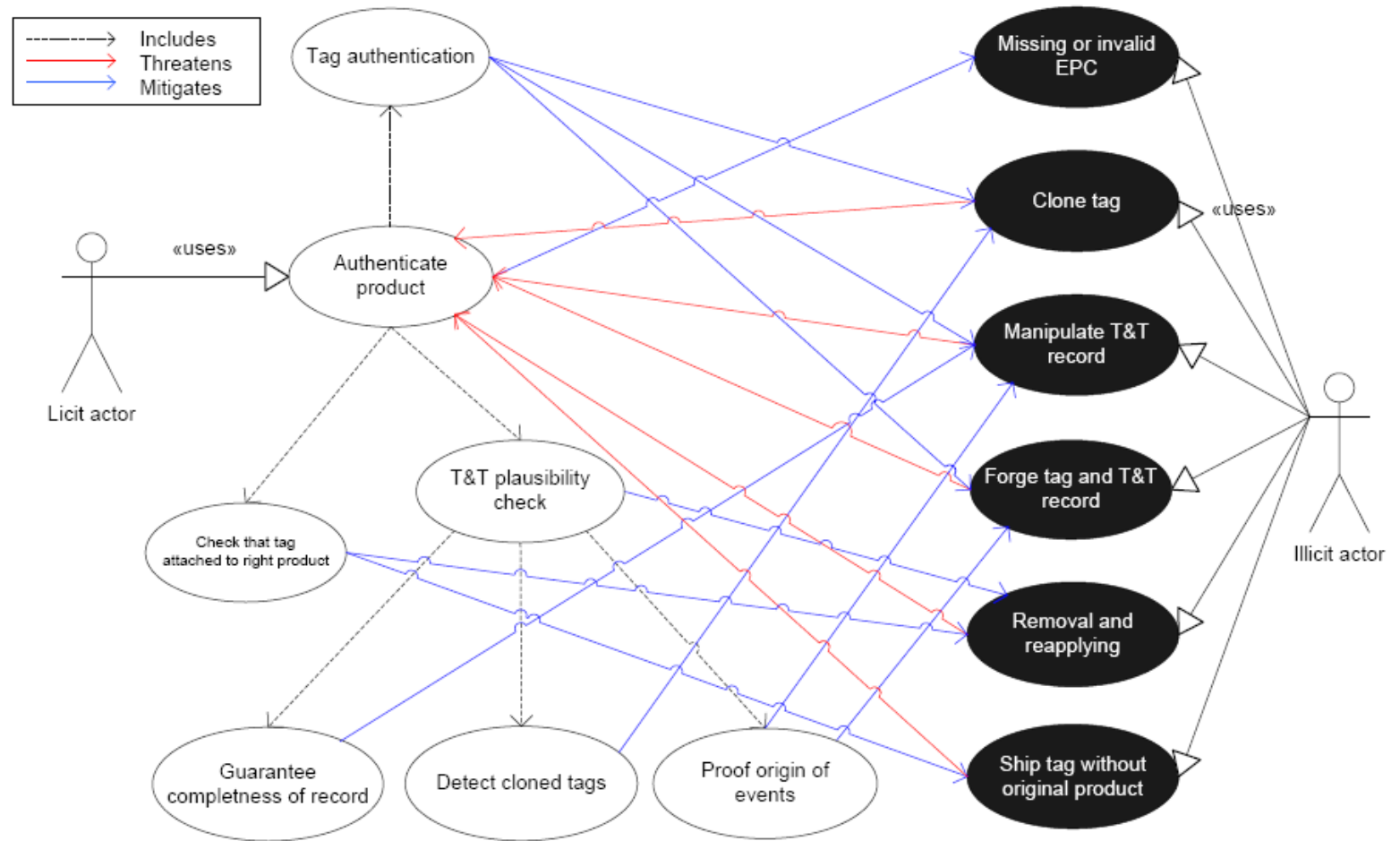




# Requirements: secure against attacks



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Page 43



Source: Mikko Lehtonen, Auto-ID Labs St. Gallen/ETH Zurich]



# Empowering the end-user: The Auto-ID Product Check



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Page 44

## Phase 1

PDA

CF-Card RFID Reader

## Phase 2

Cell-phone

NFC Reader

## Phase 3

Cell-phone

NFC/EPC Reader

EPC Network



## Auto-ID Product Check

Verify Product

Secure Authentication:



Valid product



Company:

Duracell

Product:

Ultra M3

[More information about this demo](#)



# Agenda



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Page 45

- The Problem of Counterfeits
- Promises of RFID technology
- Towards an Anti-Counterfeiting Solution
- **Current Projects**
- Outlook & Implications



# The Auto-ID Labs architect the Internet of Things. Their research is global, relevant (partner of EPCglobal), long-term, and cross-discipline



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Page 46





# The Auto-ID Labs architect the Internet of Things. Their research is global, relevant (partner of EPCglobal), long-term, and cross-discipline



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Page 47



*Auto-ID Advisory Board = EPCglobal Board of Governors, et al.*

*Auto-ID Labs Board of Directors (7 Research Directors)*

## **Business Processes & Applications**

Envision and evaluate fundamentally new business processes and industries, e.g. payment, leasing, insurance, quality management and anti-counterfeiting

## **Software & Network**

Develop future architecture of the EPC Network

## **Hardware**

Next-class tags which include memory, battery, sensors and actuators  
Improving reading rate



## Research: Mission 1 – RFID as a tool against Counterfeiting



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Page 48

“The Special Interest Group Anti-Counterfeiting will identify the true potential that RFID / EPC technology offers to combat counterfeiting”



### Research topics of the Anti-Counterfeiting Initiative:

- Business Impact
- Network Issues
- Shortcomings of the EPC Network, e.g. Security
- Cross Industry Requirements



# The SToP Project

<http://www.stop-project.eu/>



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Florian Michahelles  
25 April 2007  
Page 49

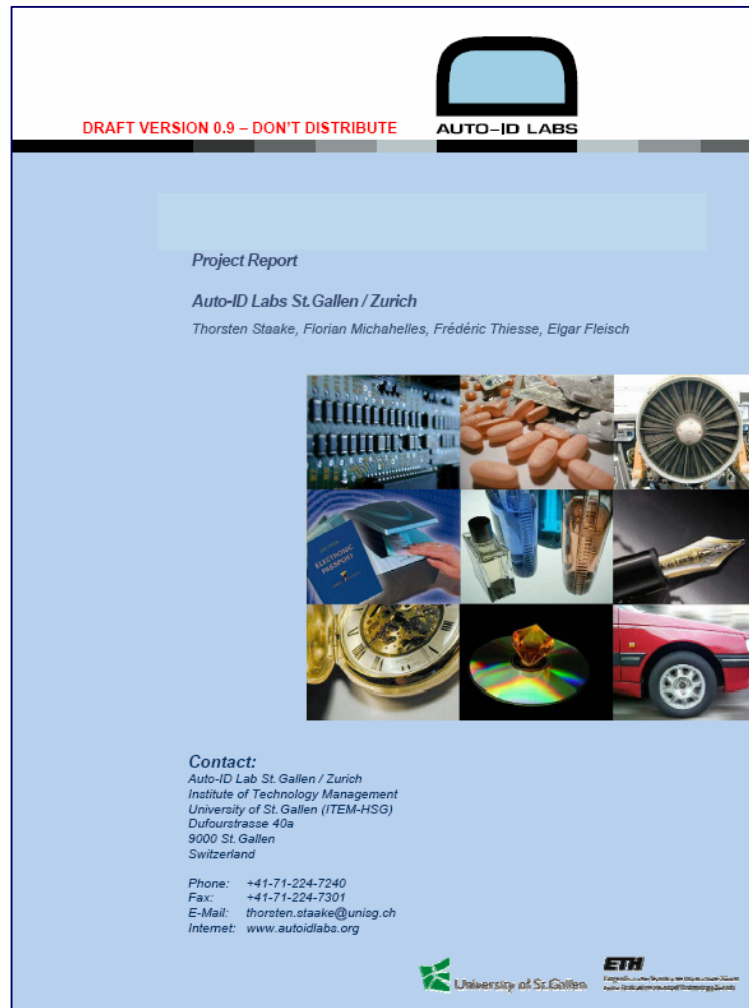
- SToP overview:
  - EU 6<sup>th</sup> Framework Programme
  - Specific Targeted Research Project (STREP)
  - Duration: 1 Nov 2006 – 30 Apr 2009 (30 months)
  - Budget
    - Total: 4 888 448 EUR
    - European Community: 2 780 000 EUR
  - SAP, Univ. St. Gallen, Spacecode, Oria Computers,
  - Novartis, Richemont, Airbus, Bundesdruckerei



# Expected outcome of StoP



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Page 50



- extend of Counterfeits
- impact of Counterfeits
- industry sector specific solutions



# BRIDGE RFID Platform



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Page 51

**WP5 Business application Anti-Counterfeiting**

**WP6 Business application Drug Pedigree**

**WP7 Business application SCM Textile Industry**

**WP8 Business application Manufacturing**

**WP9 Business application Reusable Assets Mgt.**

**WP10 Business application Products in Service**

**WP11 Business application Item Level Tagging**

**WP5**

**WP6**

**WP7**

**WP8**

**WP9**

**WP10**

**WP11**

**BRIDGE RFID Platform WP1-4**



- BRIDGE is an Integrated Project (IP)
- The duration is 3 years, starting in June 2006
- 30 partners with a balance representation of GS1 MOs, Labs, Users and Solution Providers
- The total “real cost” is €14,3M. The grant from the European Commission is €7,5M. The difference is covered by the participating companies



## BRIDGE Partners



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25 April 2007  
Page 53

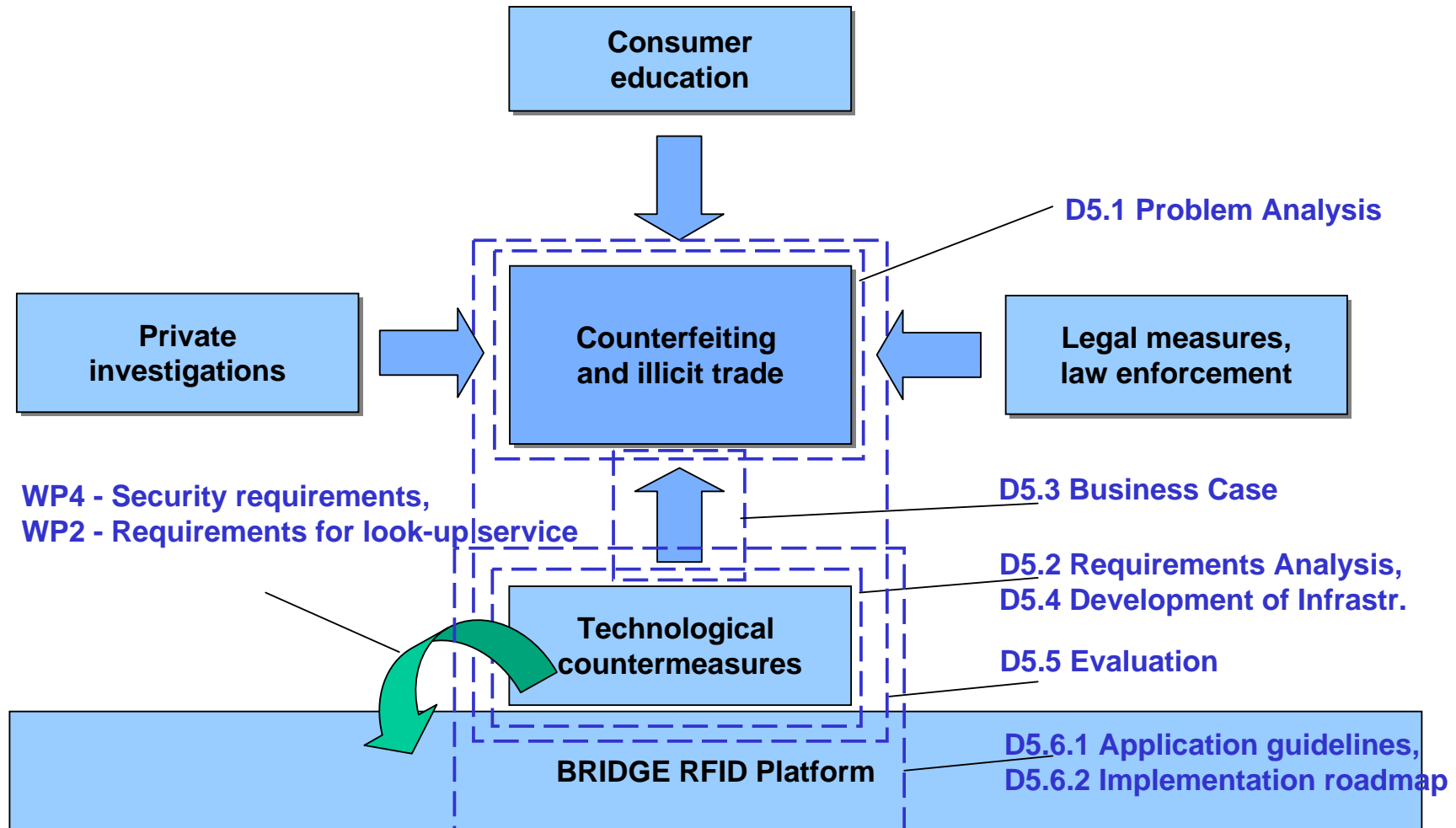
GS1	Labs	Users	Sol. Providers
GO	Cambridge	Carrefour	BT
France	St Gallen	Benedicta	SAP
UK	Fudan	Kaufhof	AIDA
Germany	UPC Barcelona	Gardeur	Caen
Spain	TUG Graz	Nestlé	Confidex
Poland		Sony	Cetecom
China		El Corte Inglés	Rafsec
			Verisign
			Melior
			Unisys
			Domino
			JJ Assoc.



# BRIDGE WP5



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25 April 2007  
Page 54





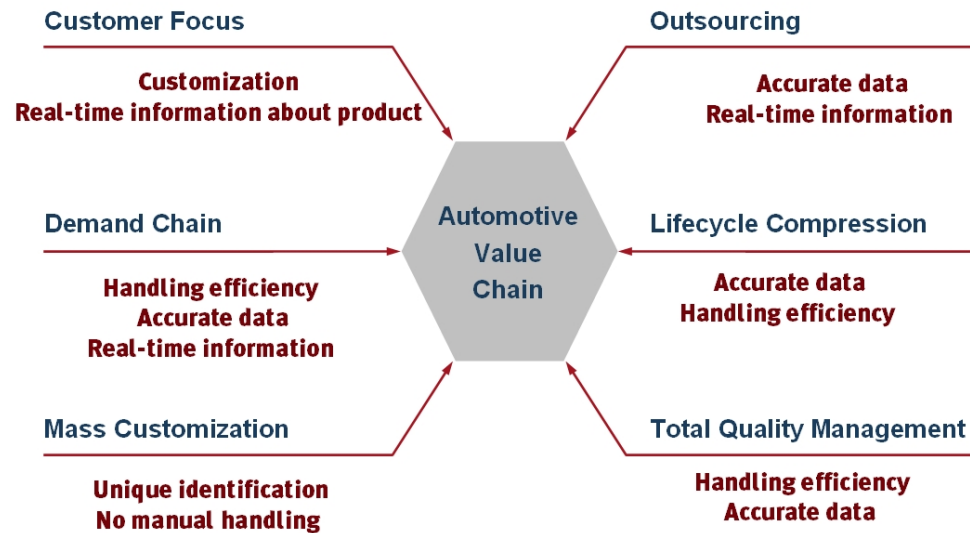
# Research: Mission 2 – RFID in new industries



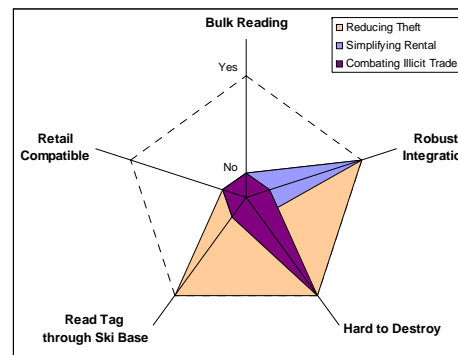
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Page 55

## • establishing RFID standards in new industries:

### • Automotive



### • Ski Industry





## Research: Mission 3 – Enhancing the EPC network



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Page 56

- transforming EPC into a trusted network
  - suitable network for secure track and trace
  - cost-efficient measurement against counterfeiting
- preparing EPC for the future
  - integration of sensors on tag
  - sharing of sensor data across the network
  - data access
- developing/enhancing ONS
  - P2P approaches
  - OpenSource EPC network



# Agenda



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25 April 2007  
Page 57

- The Problem of Counterfeits
- Promises of RFID technology
- Towards an Anti-Counterfeiting Solution
- Current Projects
- Outlook & Implications



# Non-functional requirements of secure product authentication



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Page 58

- Availability: all genuine products must be tagged, the tags must work
- Trust in parties who authenticate products
- Data sharing policies (for track and trace based approach)



# “Weak products authentication” with RFID



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25 April 2007  
Page 59

1. Putting an RFID tag on genuine products detects fakes that are not tagged
2. Verifying ID numbers detects fakes that don't have valid IDs
3. Verifying the transponder ID number (EPC Class-1 Gen 2 tags) makes the genuine tags harder to copy
4. Verifying if the product has already been checked helps detecting some cloned tags



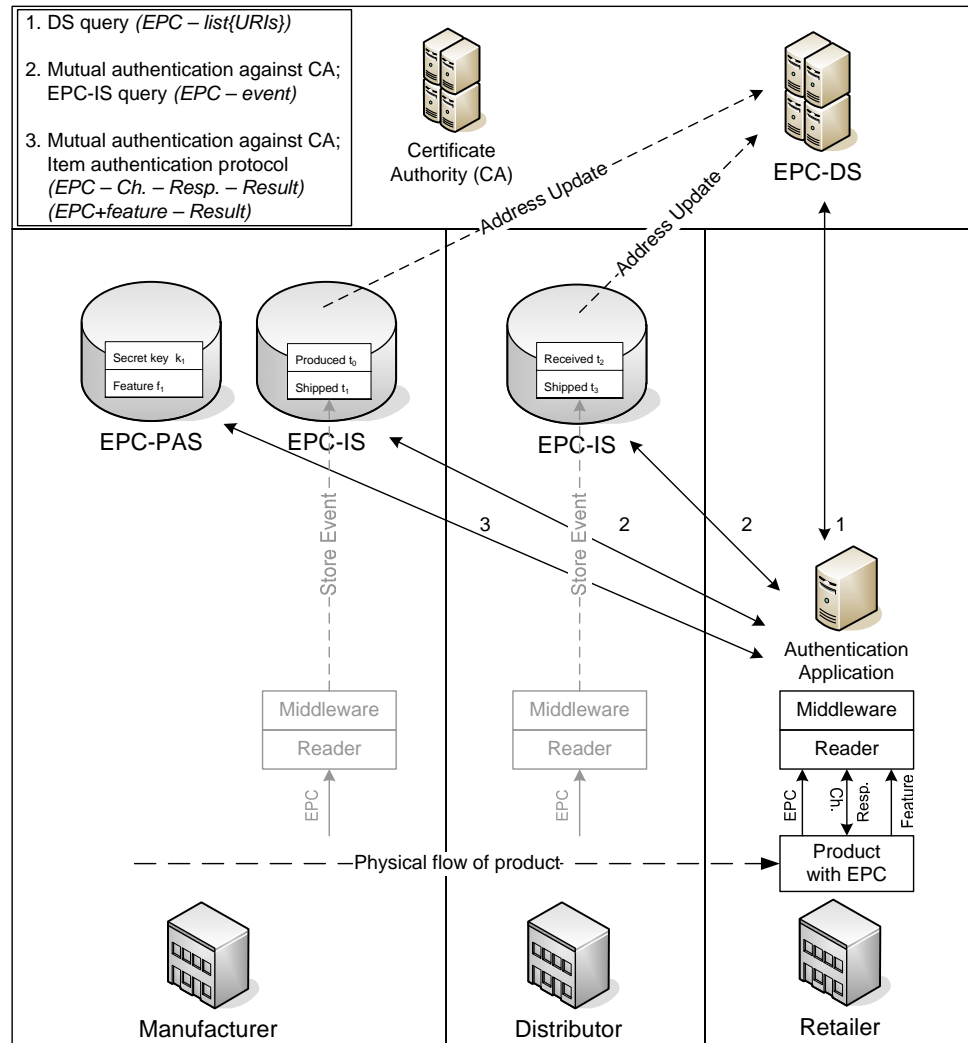
**Not a 100% secure system, but increases the effort to clone a product.  
Good solution for short-term or for inexpensive products.**



# Long term goal: Product authentication in the EPCnetwork

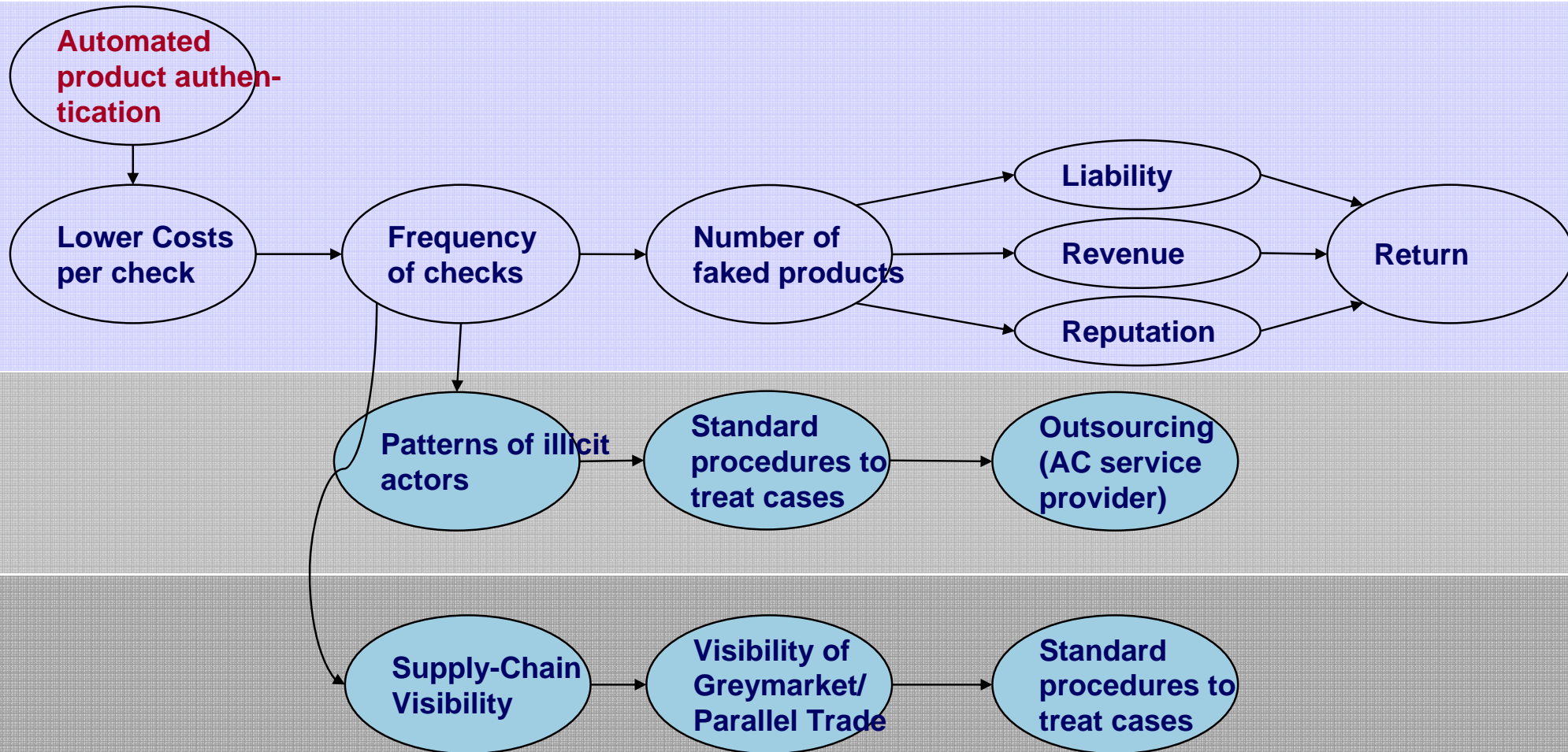


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Page 60





## Implications and Long-Term vision...





...calls for a comprehensive infrastructure of the  
**internet of things.**



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Page 62

## Core Characteristics:

- look-up service
- quality of real-time
- trusted parties
- defined ownership of data
- scalable data access model
- life-cycle of data



# Use Cases of Product Authentication



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Page 63

- Product authentication is a tool that can be used to find counterfeit products
- This tool can be used to achieve following goals
  1. Prevent counterfeits from entering the licit distribution channel
  2. Help customs to detect infringing products
  3. Keep sales-points and end-points clean from counterfeits
  4. Enable authentication of products that are in use
  5. Enable after sales services to authenticate products
  6. Help private investigators



## Take home message



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Page 64

- There is no business model for anti-counterfeiting, it is not about ROI, but it is about
  - trust
  - customer safety
  - brand protection
  - countermeasures against future competitors