

How CAN **electronic** seals assure container integrity that mechanical seals CANNOT?

Aspects of Container Security

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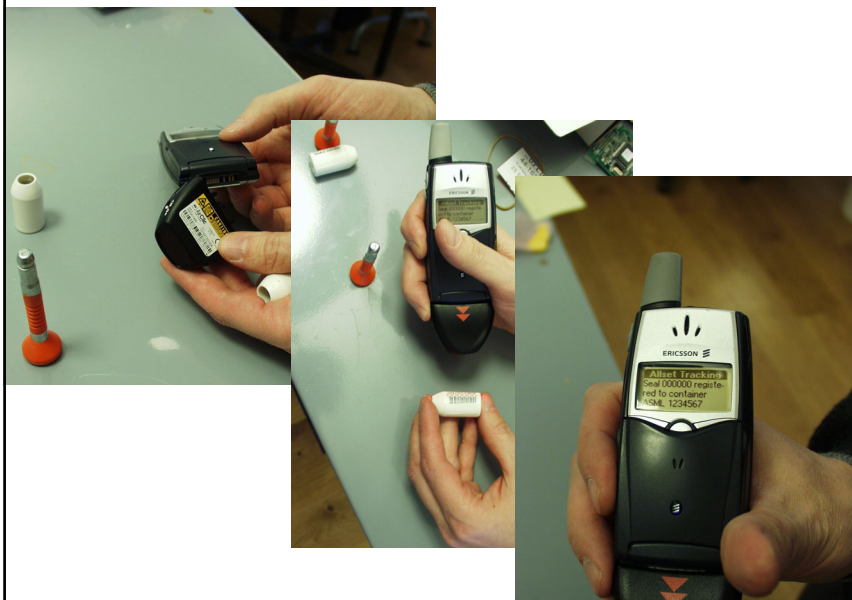
Mechanical vs. **Electronic** Seals

- Mechanical seals are primarily used for **anti-theft**
- A mechanical seal can more easily be **copied** or by-passed
- Mechanical seals require **manual** inspection
- Electronic seals are also used for **anti-terrorist** purposes
- An electronic seal can detect **tampering**
- Electronic seals **automatically** captures data (AEI)

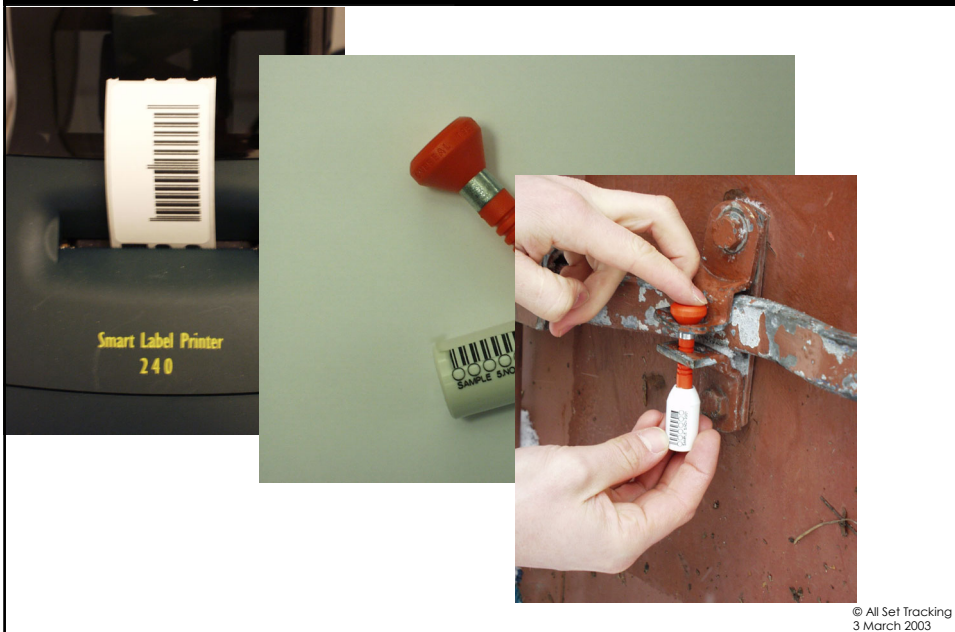
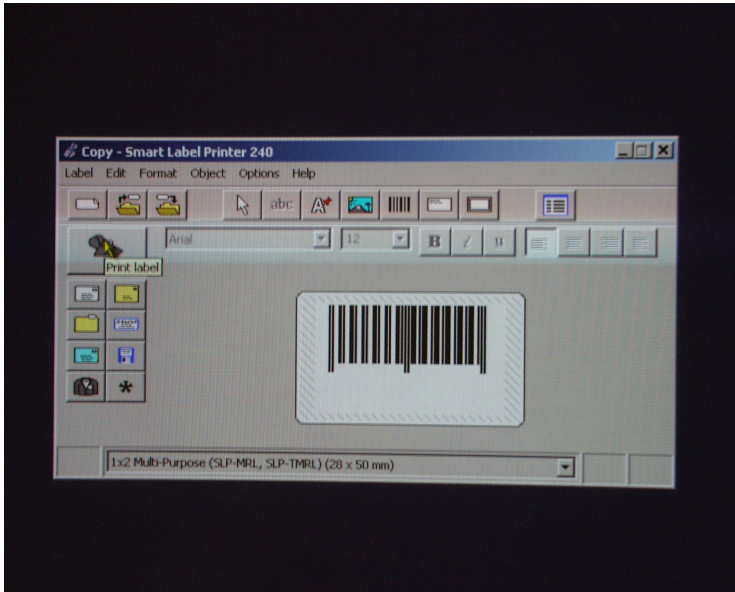
Case 1: How to copy a mechanical seal



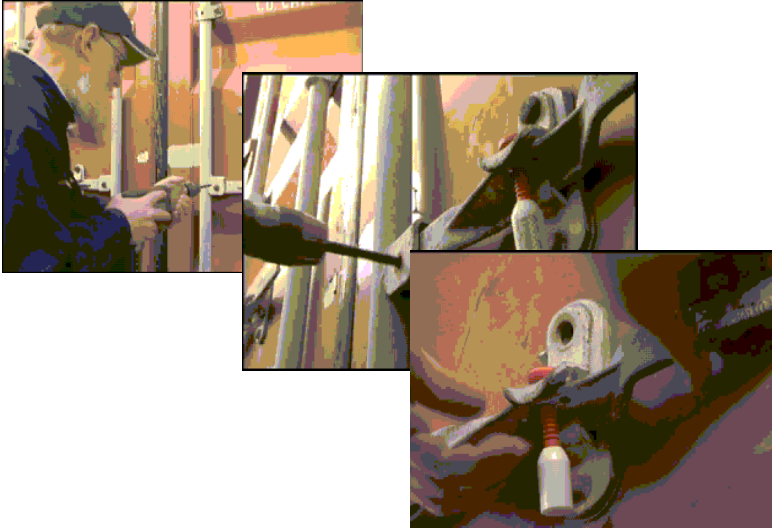
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Case 2a: How to by-pass a mechanical seal



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Case 2b: How to by-pass a mechanical seal



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What are the **criteria** for full implementation and universal use of electronic seals?

1. Global applicability without radio regulatory problems
2. Economical enough and beneficial for ordinary commercial use
3. Easy to apply & easy to integrate in business processes
4. Electronically secure
5. Expandable to future technologies

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How can an e-seal system **meet** these criteria?

1. **Global**

- World wide license-free radio frequency
- Scalable number of readers

2. **Economical**

- Piggy-back on existing communication network infrastructure
- Achieve economies of scale from other industries/applications
- Non-recurring cost per move (not disposable or recyclable)
- Cost savings in operation (time for manual input)
- More value add to carriers than just e-sealing

3. **Easy**

- No recycling
- Permanent installation

4. **Secure**

- Secure protocol
- Seal ID encrypted or not sent over the "air"

5. **Expandable**

- Connection via external data ports
- Accommodates standard interfaces and standard

How can the industry **benefit** from e-seals?

- Improve port gate efficiencies creating a "fast lane"
- Reduce manual data input for tally and registration
- Facilitate electronic bills of lading for the "24 hours" advance notice
- Improve information quality and timeliness to shippers, carriers and governments
- Better security against pilferage and other types of irregularities

Pre-requisites for a **secure** e-seal solution

- Electronic seal shall not be possible to duplicate
- All communication to the e-seal shall be secure or encrypted
- The e-seal must be authenticated (using challenge-response when sealing is read)

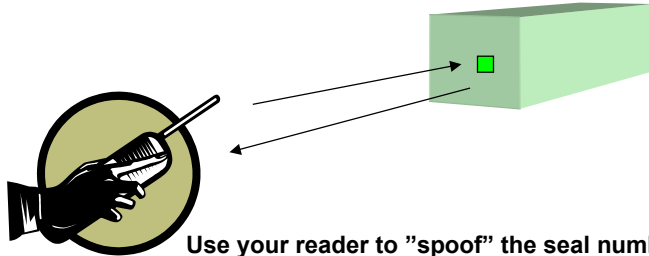
Case 3: How to **copy** an electronic seal (with no Secure Sealing protocol)

Step 1

- Steal a reader
or...
- Build a simple reader according to the open specification

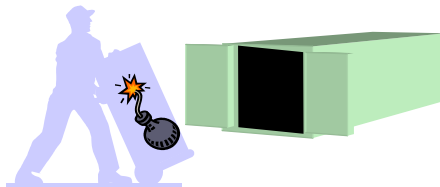


Step 2



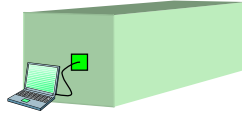
Use your reader to "spoof" the seal number

Step 3



Open the container and put something in it!

Step 4



Close doors and reprogram the existing seal with the sealing key or put on a duplicate, fake e-seal!

READY!

Case 2a: How to **securely** seal a container

5) Seal key generated and encrypted with secret seal code as input



Authentication Server

3) Select container to seal

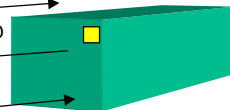


Handheld Reader

1) Request ID

2) Send ID

7) Seal key decrypted and stored in tag



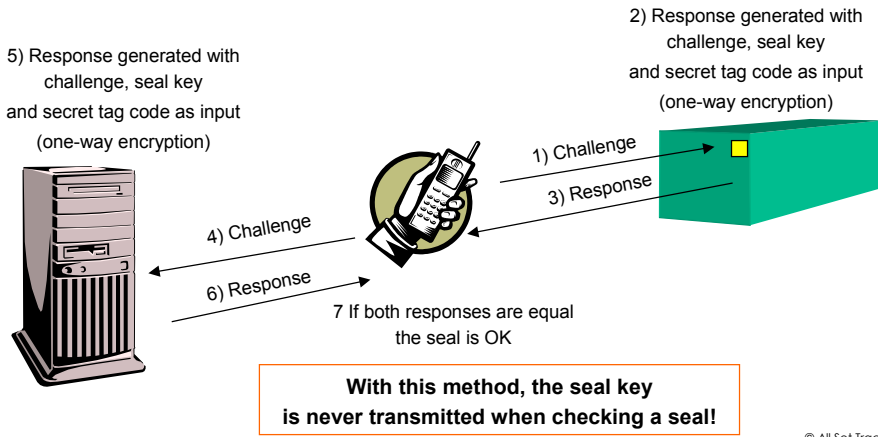
E-Seal

4) Sealing request

6) Encrypted seal key

When container door is opened (seal is broken), the seal key will be erased in tag

How to check sealing



Are there any truly global and license-free frequencies today?

	433 MHz	862-928 MHz	915 MHz	2.4 GHz
USA	Yes	No	Yes	Yes
Europe	Yes	Yes	No	Yes
China	No	No	No	Yes
Japan	No	No	No	Yes
Malaysia	No	No	No	Yes
Korea	No	No	No	Yes

Are there any truly global and license-free frequencies today?

	433.92 MHz	862-928 MHz	915 MHz	2.4 GHz
Europe + South Africa	Yes	Yes	No	Yes
USA	Yes	No	Yes	Yes
China	No	No	No	Yes
Japan	No	No	No	Yes
Malaysia	No	No	No	Yes
Hongkong	Yes*	No	No	Yes
Singapore	No	No	No	Yes
Korea	No	No	No	Yes
Other Asia	No	New Zealand	Australia	Yes

*) Pending and limited

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Power levels: e.i.r.p. (highest value)

	433.92 MHz	862-928 MHz	915 MHz	2.4 GHz
Europe + South Africa	10 mW	2 W (25 mW)	No	4 W* (10 mW)
USA	36 μ W*	No	4 W	4 W
China	No	No	No	21 mW
Japan	No	No	No	1 W
Malaysia	No	No	No	-
Hongkong	0,1 mW**	No	No	100 mW
Singapore	No	No	No	100 mW
Other Asia	-	New Zealand: 100 mW	Australia: 1 W	-

*) Duty cycle <0.15, Ton=30 ms, Toff=170 ms

**) Pending and limited

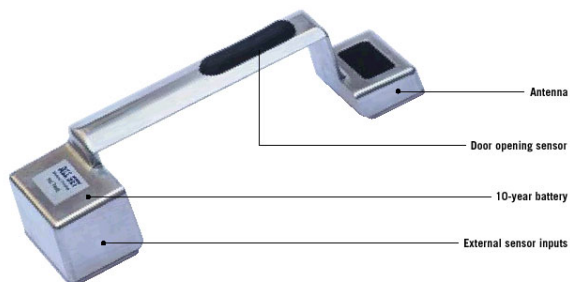
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Summary of important attributes

Technical Performance	Passive RFID		Active RFID		Bluetooth "Lite"	
Secure communication	No		No		Yes	1
Secure authorization and authentication	No		No		Yes	1
Global Availability	No		No		Yes	1
Frequency License-Free	No		No		Yes	1
Reading Range	1-3 m.		30-100 m.	1	>30 m.	1
Automatic Reading	No		Yes	1	Yes	1
Reusable	No		Yes	1	Yes	1
Recycling required	No	1	Yes		No	1
Tamper proof	Yes	1	No		Yes	1
Physical protection	No		No		Yes	1
Intrusion barrier	Yes	1	Yes	1	Yes	1
Sensor capability	No		Yes	1	Yes	1
Tracking functionality	No		Yes	1	Yes	1
Multifunction "3 in 1"	No		No		Yes	1
Fast Installation	Yes	1	Yes	1	Yes	1
		4		7		15

The future of e-seals: "3-in-1"

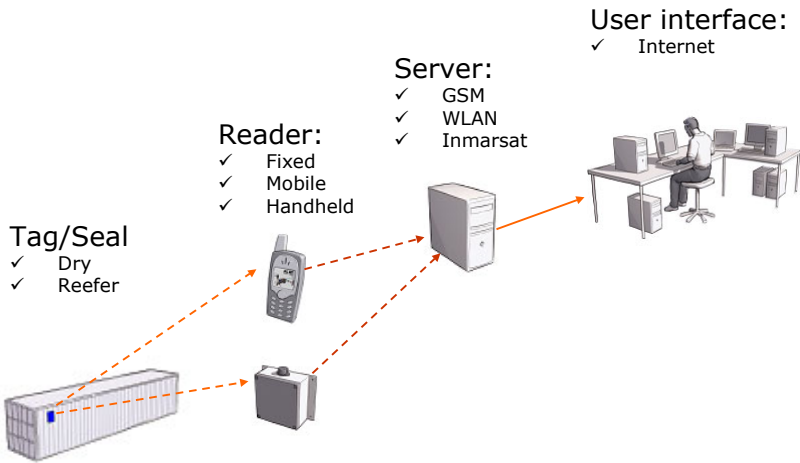
1. Secure Electronic Sealing
2. Global Tracking
3. Sensor Connectivity



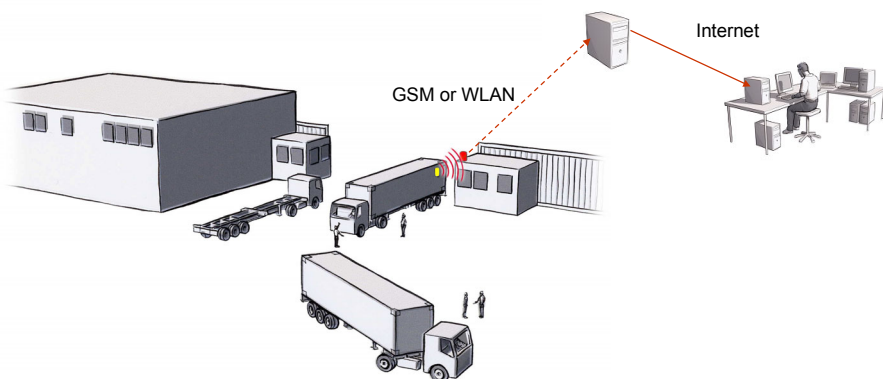
How to create a smart container?



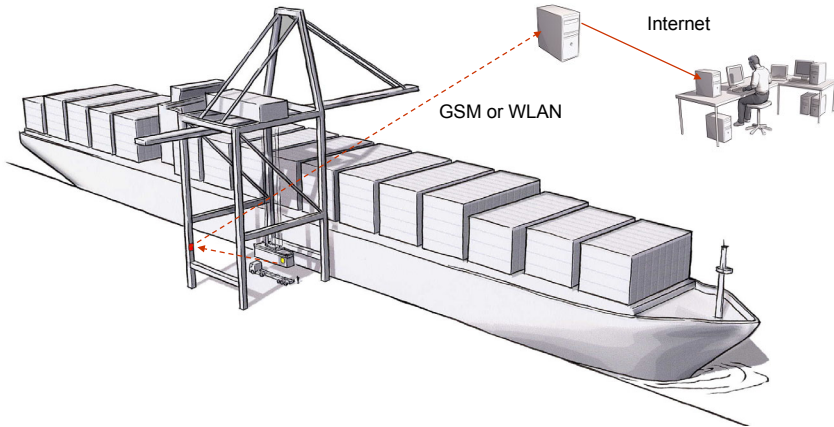
A system approach



Fixed Reader: gate

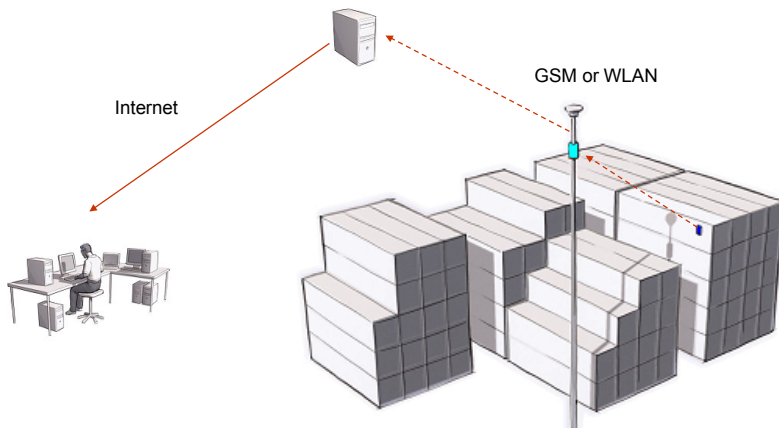


Fixed Reader: crane

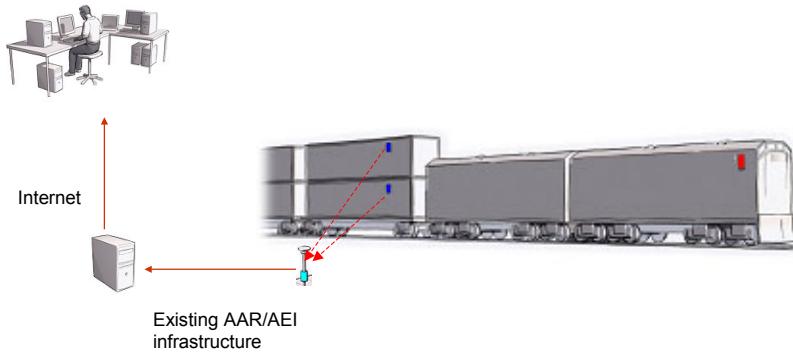


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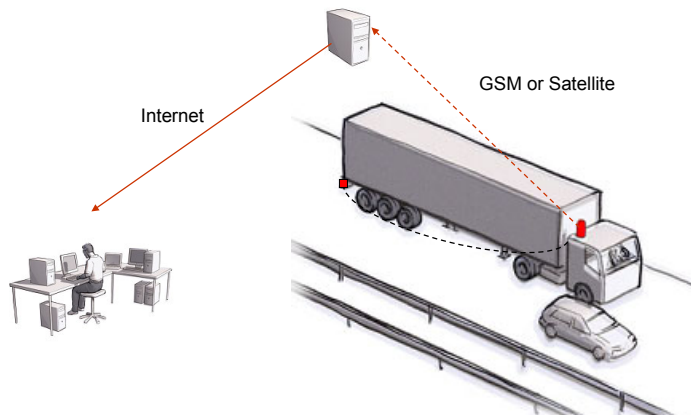
Fixed Reader: yard



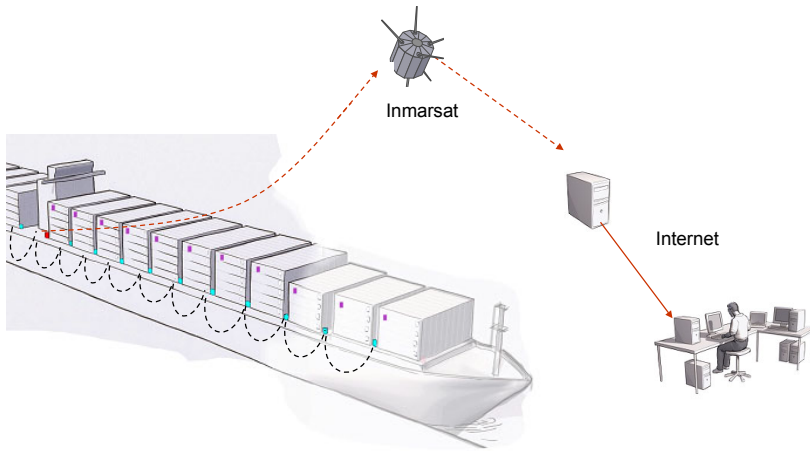
Fixed Reader: train



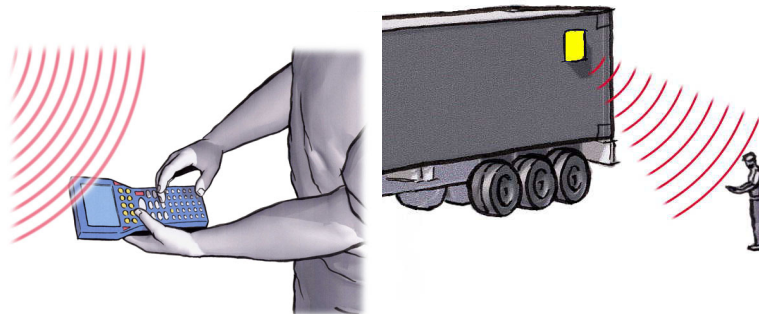
Mobile Reader: truck



Mobile Reader: ship



Handheld Reader



Which is more economical: a disposable or a permanent e-seal?

Hardware Cost	Disposable e-seal	Permanent e-seal
unit price (volumes of 1 million)	\$5	\$50
sealing cost per move	\$5	\$0,50
moves per box and year	10	10
number of boxes	100 000	100 000
total moves per year	1 000 000	1 000 000
Total sealing cost per year	\$5 000 000	\$500 000

How much does a reader infrastructure have to cost?

Reader Infrastructure	Passive RFID	Bluetooth "Lite"
unit price	\$2 000	\$150
number of readers	100	100
reader cost per port	\$200 000	\$15 000
number of ports	200	200
Total reader cost	\$40 000 000	\$3 000 000

Thank you for listning.

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