Automated Identification Technologies (AIT): Improving the Management of Forensic Evidence

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NIST Forensic Sciences (FS) Program

NIST Mission: Advance measurement science, standards, and technology in ways that −

- Promote U.S. innovation and industrial competitiveness

- Advance measurement science, standards, and technology

- Enhance economic and physical security

- Improve our quality of life

Forensic Science Program

Manages programs and directs research to advance forensic science technologies by developing performance standards, guidelines, and reports of research findings

Technical Working Group on Biological Evidence Preservation (TWGBEP)

- Convened from August 2011 - January 2013

- Charged to: "create best practices and guidance to ensure the integrity, prevent the loss, and reduce the premature destruction of biological evidence after collection through post-conviction proceedings"

- Key Output: ***The Biological Evidence Preservation Handbook*** published in April 2013

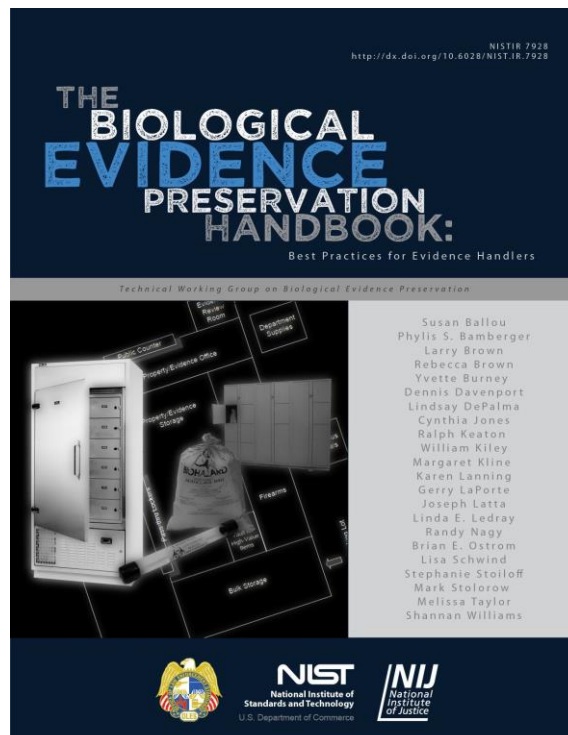# Automated Identification Technology (AIT) Assessment Project

TWG wanted to conduct an assessment of AIT technologies to:

- Identify, categorize, and evaluate where AIT is already being explored or used in the forensic evidence process

- Assist in defining process changes and leveraging AIT, which could provide greater visibility into the forensic evidence processes

- Develop a model to conduct a return on investment analysis to determine "business case" for implementing RFID

Based on results of the assessment, TWGBEP created Recommendation IV-6.

Recommendation IV-6 of *The Biological Evidence Preservation Handbook* reads,

"Overall, it is highly recommended that jurisdictions consider automated identification technologies to enhance chain-of-custody recordkeeping and tracking, to facilitate inventories, and to allow for efficient retrieval of evidence."

Published April 2013
Available at:
http://www.nist.gov/oles/forensics/bioev.cfm

What are automated identification technologies (AIT)?

Automated identification technologies (AIT) enables the *capture, collection, and transfer* of data in order to automatically identify objects and enter data about that object directly into computer systems with little to no human involvement.

Examples of AIT include:

- **Barcodes**

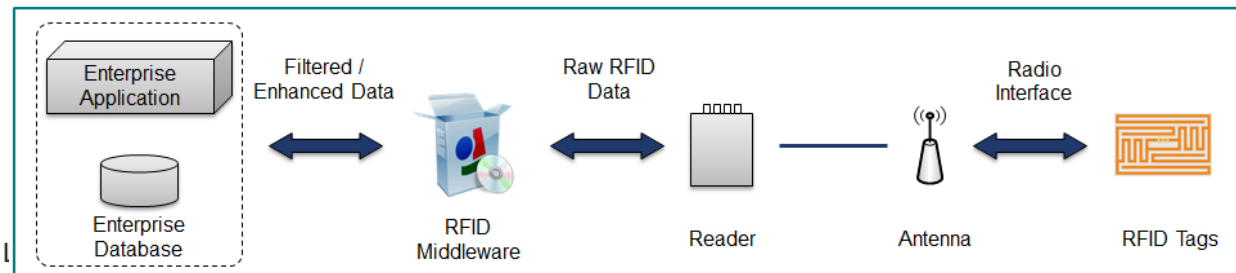- **Radio Frequency Identification (RFID)**

What is Radio Frequency Identification (RFID)?

RFID is an established AIT that uses radio waves to perform automatic data acquisition.
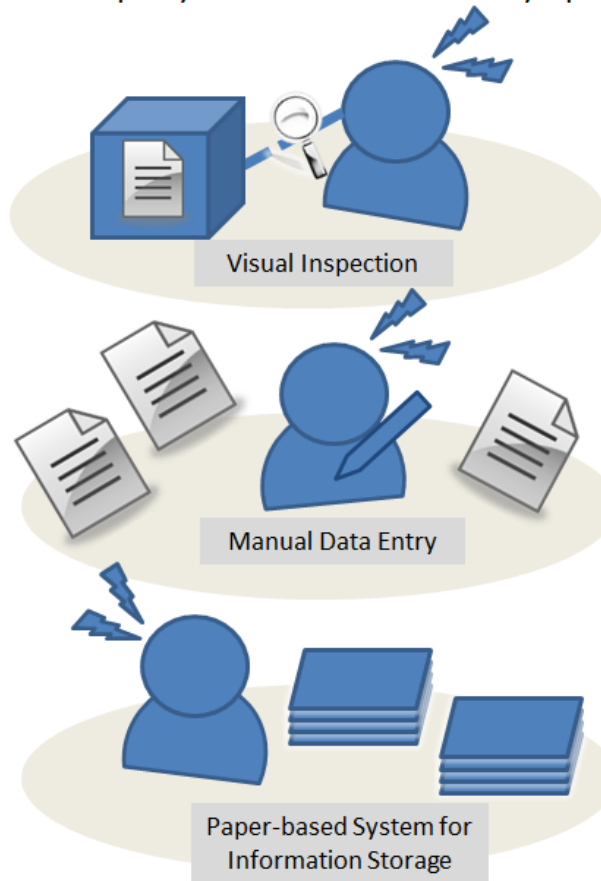
A typical RFID system includes:
- *RFID Tag* – Has information about item programmed into it
- *Reader/Antenna* – Retrieves the data from the tags
- *RFID Middleware* – Makes sense of data retrieved from reader
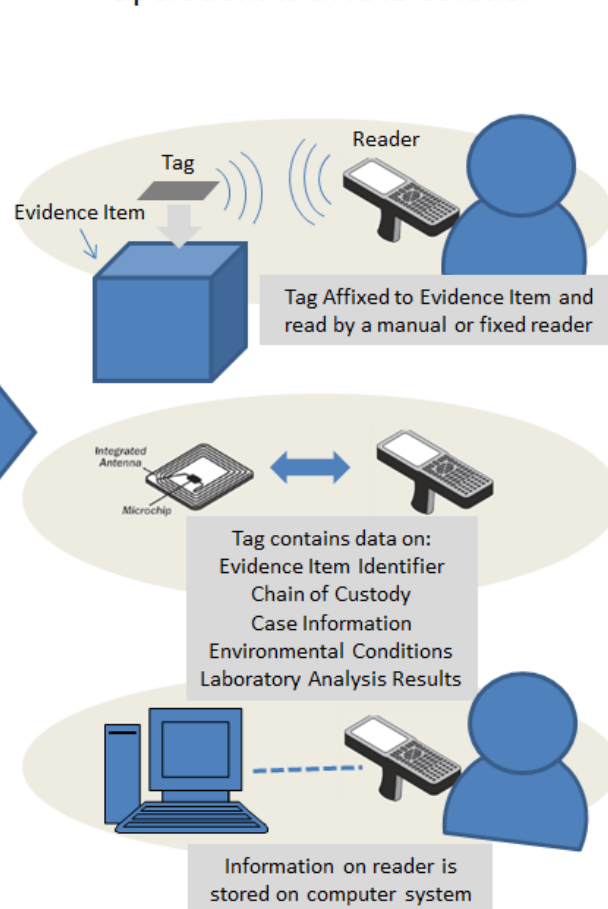- *Enterprise Applications and Database* – Integrates data with business applications

What is Radio Frequency Identification (RFID)?

What is Radio Frequency Identification (RFID)?

There are three types of RFID tags:

Type	Description	Example
Active RFID	RFID Tag that is **equipped with a battery** that can be used as a partial or complete source of power for the tag's circuitry and antenna. It can be **read at distances of 100 feet** or more, greatly improving the utility of the device. The onboard battery **can also be used to power sensors** (i.e., temperature, open/close status, etc.).	
Passive RFID	RFID Tag that **does not contain a battery; the power is supplied by the reader.** When radio waves from the reader are encountered by a passive RFID tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag. The tag then **sends the information encoded in the tag's memory**. The tag can be **read only at very short distances, typically a few inches for high frequency and up to 20 feet for ultra-high frequency**. It is typically not possible to include sensors on passive tags because they lack an onboard power source.	
Battery Assisted RFID	BAP RFID tags, like Active RFID, **contain an integrated power source**. This power source eliminates the need to gather energy from the reader and wake up the chip. For management's budget, BAP tags can be much less expensive than Active RFID tags. Some BAP tags can also support sensors.	

Barcodes versus RFID

Type	Description	Example
Linear Barcodes	Linear Barcodes are composed of bars and spaces all in a single line. Linear Barcodes cannot store much data. They **can typically store nine data characters for every inch** of horizontal barcode space. Linear Barcodes **can be read by virtually every scanner in the world** and are easy to print. The UPC is an example of a Linear Barcode.	
2D Barcodes	2D Barcodes consist of **black and white "cells" or module**s arranged in either a square or rectangular pattern. The information to be encoded can be text or raw data. Unlike Linear Barcodes, 2D Barcodes **can store up to 2 kilobytes of data**. Most state motor vehicle associations use 2D Barcodes when issuing drivers licenses.	

Barcodes versus RFID

Advantages of Barcoding

- Barcodes are the least expensive way to identify assets/items.

- Barcodes offer a simple method to automate the data capture of the data on a barcode.

Advantages of RFID

- UHF and battery-assisted tags can be read at far greater distances, scanned much faster, and can be automatically scanned

- RFID tags can be read and written in large numbers

- RFID-enabled applications can be engineered in such a way that the movement, number, and specific type of the items, as well as timing and frequency of events, can all be monitored at a distance.

RFID Return on Investment (ROI) Analysis

- Hypothetical model based on estimated cost savings in reduced time to conduct standard searches, exception searches, and inventories
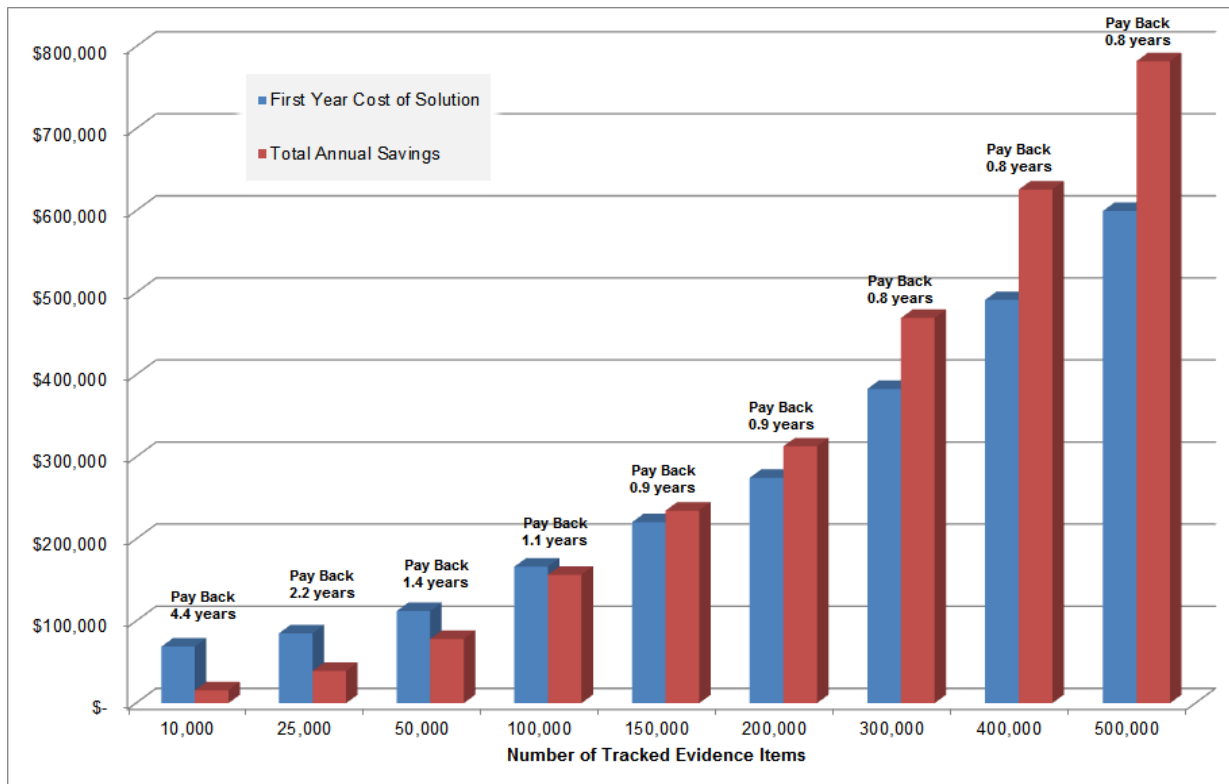
Estimated payback time is smaller in larger agencies with larger numbers of tracked evidence items

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Barriers to RFID Adoption

1. Magnitude of Startup Cost
2. Reliability of Technology
3. Process Standardization

As a result, only a handful of law enforcement agencies have successfully implemented RFID based property and evidence solutions.

Examples:

  - Netherlands Forensic Institute

  - Santa Clara Crime Lab

Proposed Recommendations

1. Law enforcement agencies should analyze current evidence handling process to identify areas that can benefit from AIT adoption.

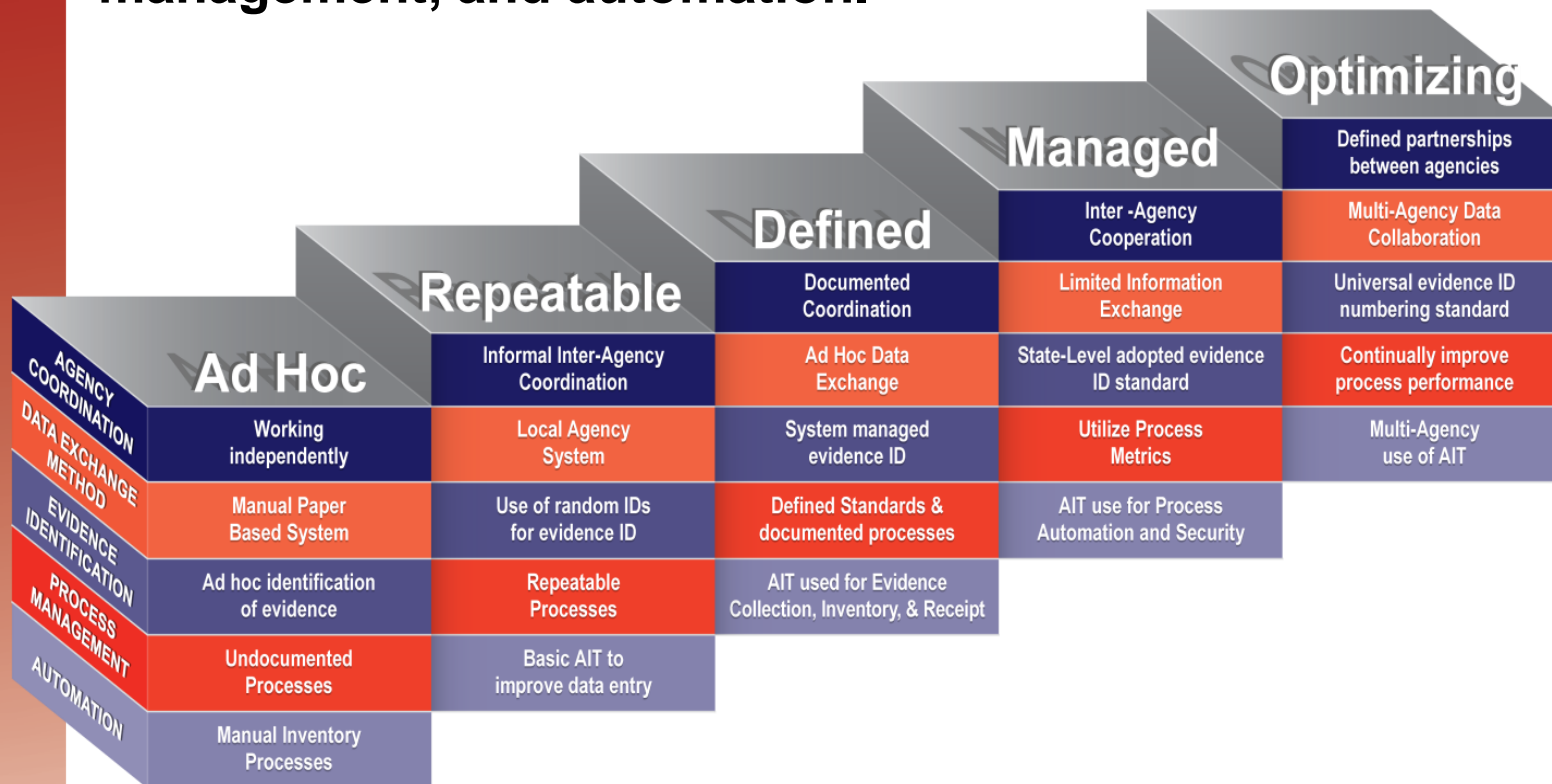**Table 7-1: AS-IS vs. TO-BE Business Processes Comparison**

Process Name	AS-IS	To-Be	Potential Benefits
Package Evidence	• Collection is manual • Identification method is organization specific • Paper based chain of custody initiation	• Electronic Chain of Custody • AIT used in collection of evidence by labeling and entering evidence information at crime scene • Unique Identifiers applied to evidence during collection	• Reduced time for cataloging of evidence • Automated initiation of chain of custody
Complete Submission for Processing	• Manual documentation of case details • Manual application of evidence identification • Paper based chain of custody	• Documentation of Case Details via IT system • Electronic Chain of Custody	• Reduced time for evidence submission • Automated chain of custody
Evidence Receipt	• Visual verification of each item of evidence by custodian • Manual documentation in property record • Paper based property record • Paper based chain of custody	• Automated verification of evidence using AIT. System will compare expected items with what has been scanned in. System will alert user if discrepancies are detected • Automated registration of evidence in IT based property register • Electronic Chain of Custody	• Automation of human readable and electronic labels • Automated chain of custody
Evidence Storage	• Manual documentation of location in property record	• Automated registration of location IT based property register	• Reduced time in searching for evidence
Temporary Evidence Release	• Paper based chain of custody	• Electronic Chain of Custody	• Improved visibility into items released to other organizations

Agencies should record and analyze business processes to see where AIT can improve efficiency

Excerpt from draft report

Proposed Recommendations

2. Law enforcement agencies should work to optimize the use of AIT technologies such as RFID by enhancing agency coordination, data exchange methods, process management, and automation.

	Ad Hoc	Repeatable	Defined	Managed	Optimizing
AGENCY COORDINATION	Working independently	Informal Inter-Agency Coordination	Ad Hoc Data Exchange	Inter-Agency Cooperation	Defined partnerships between agencies
DATA EXCHANGE METHOD	Manual Paper Based System	Local Agency System	System managed evidence ID	Limited Information Exchange	Multi-Agency Data Collaboration
EVIDENCE IDENTIFICATION	Ad hoc identification of evidence	Use of random IDs for evidence ID	Defined Standards & documented processes	State-Level adopted evidence ID standard	Universal evidence ID numbering standard
PROCESS MANAGEMENT	Undocumented Processes	Repeatable Processes	AIT used for Evidence Collection, Inventory, & Receipt	Utilize Process Metrics	Continually improve process performance
AUTOMATION	Manual Inventory Processes	Basic AIT to improve data entry		AIT use for Process Automation and Security	Multi-Agency use of AIT

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Proposed Recommendations

3. Law enforcement agencies management should utilize the experiences of commercial organizations to overcome barriers to adoption in law enforcement.

Table 7-2: Overcoming Barriers for AIT Adoption

Barrier	Description	Resolution	Commercial Example
Lack of Compatible Solutions	Some vendors have applied AIT technology to the forensic evidence process, but the lack of common processes and common data format has resulted incompatible solutions.	Work with other law enforcement organizations (i.e. labs, courts, attorneys, etc.) to help develop and define standards and processes for handling evidence. Once standards are in place engineers and systems integrators can tailor and design compatible solutions.	RFID solution vendors developed dock door portal readers for use in warehousing shipping and receiving processes. RFID solution vendors were able to develop a solution for these processes because dock door configurations and most shipping and receiving processes are standardized across multiple industries.
Forensic Evidence is Different	Law enforcement agencies believe that due to the nature of property and evidence and the manner in that it is stored, that advanced AIT technologies are not reliable.	The key factor in improving the reliability of the technology is to have industry approved standards and processes for handling and storing evidence. Once standard processes have been established, many of the advantages AIT has provided to other applications will also apply to forensic evidence.	In various pilots pharmaceutical distributors demonstrated the ability to automatically read and verify items in a case of pill bottles from a manufacturer without ever having to open the case and scan each individual bottle. This was achieved due to the standard approach to labeling of pill bottles and where they were placed on the bottles.
Forensic Evidence is Complex	Some believe that AIT would be costly and show little benefit because of law enforcements multi-agency environment and the multitude of unique processes being used for handling evidence.	In order for a law enforcement agency to achieve the full benefits of implementing AIT, standard processes and procedures must be established. These standards and procedures should cover all aspects of evidence handling.	Commercial industries also work with many partners with unique processes, but over time, these processes have been harmonized to capture cost savings that are mutually beneficial. For example, supply chain distribution processes (i.e. shipping, receiving, and packing) have become standardized at a high level. This has allowed vendors to create solutions for these specific processes

Commercial organizations have encountered similar problems in implementing RFID and can provide insight on solutions
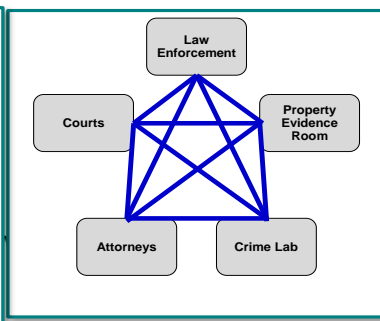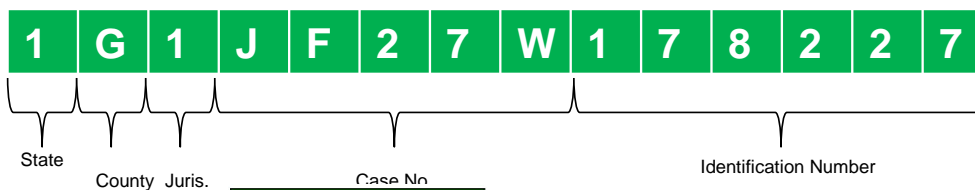
Excerpt from draft report

Proposed Recommendations

4. Regional and state level agencies need to address several foundational issues to facilitate the adoption of AIT throughout the law enforcement community. These issues include the creation of:

      a. Numbering standards;

      b. Evidence labeling standards; and

      c. Data exchange methodology.

Proposed Recommendations

4. Federal level stakeholders should take steps to facilitate further research into the existence of standards applicable to AIT's use in law enforcement and convene relevant participants to develop standards where there are gaps.

RFID Technology in Forensic Evidence Management: An Assessment of Barriers, Benefits, and Costs to Implementation

Publication Scheduled for Spring 2014

Will be located at:

http://www.nist.gov/oles/forensics/bioev.cfm

Questions?

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