Department of Defense

Biometrics Identity Management Agency

National Information Exchange Model

Electronic Biometric Transmission Specification

Information Exchange Package Documentation

DoD EBTS IEPD 1.0

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Revision History

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1   Introduction

The National Information Exchange Model (NIEM) is an XML-based standard for information exchange. The NIEM is a United States (US) government-sponsored initiative to facilitate information sharing within government organizations and their business partners. The NIEM can help organizations meet the requirements of HSPD-5, Homeland Security Presidential Directive 5: Management of Domestic Incidents [5], and associated Executive Orders. HSPD-5 directs the Department of Defense (DoD) to establish appropriate relationships and mechanisms for cooperation and coordination with other departments and agencies responsible for protecting national security.

The DoD Electronic Biometric Transmission Specification (EBTS) Information Exchange Package (IEP) is a collection of XML schemas, XML instance documents, and other information artifacts that document the rules governing the exchange of biometric information with the United States DoD. This Information Exchange Package Documentation (IEPD) is based on the DoD EBTS 3.0 standard [4]. This IEPD is the document that describes the contents and use of all the artifacts included in the package.

2   EBTS IEPD

2.0   Contents and Use

The DoD EBTS 1.0 IEPD contains files required by the NIEM IEPD specification for the XML documents defined using the DoD EBTS 3.0 standard. To view the IEPD files, extract all of the files from the zip archive to a folder, then open the file named catalog.html in a browser. Once extracted from the archive, all of the files in the package can be accessed through hypertext links in the catalog.html file.

2.1   Schemas

The DoD EBTS 3.0 XML schema relies upon other schemas, reusing their elements whenever possible rather than defining new elements that would serve the same purpose as those that already exist. The schemas that DoD EBTS 3.0 relies on are NIEM compliant schemas, and some are defined in U.S. national standards[1]. This set of NIEM compliant schemas serves is the base upon which the DoD EBTS 3.0 XML schema is built.

The schema relationships are illustrated in the following figure:

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[1] DoD EBTS 3.0 schemas are included in the DoD Metadata Registries Biometrics Namespace Domain.
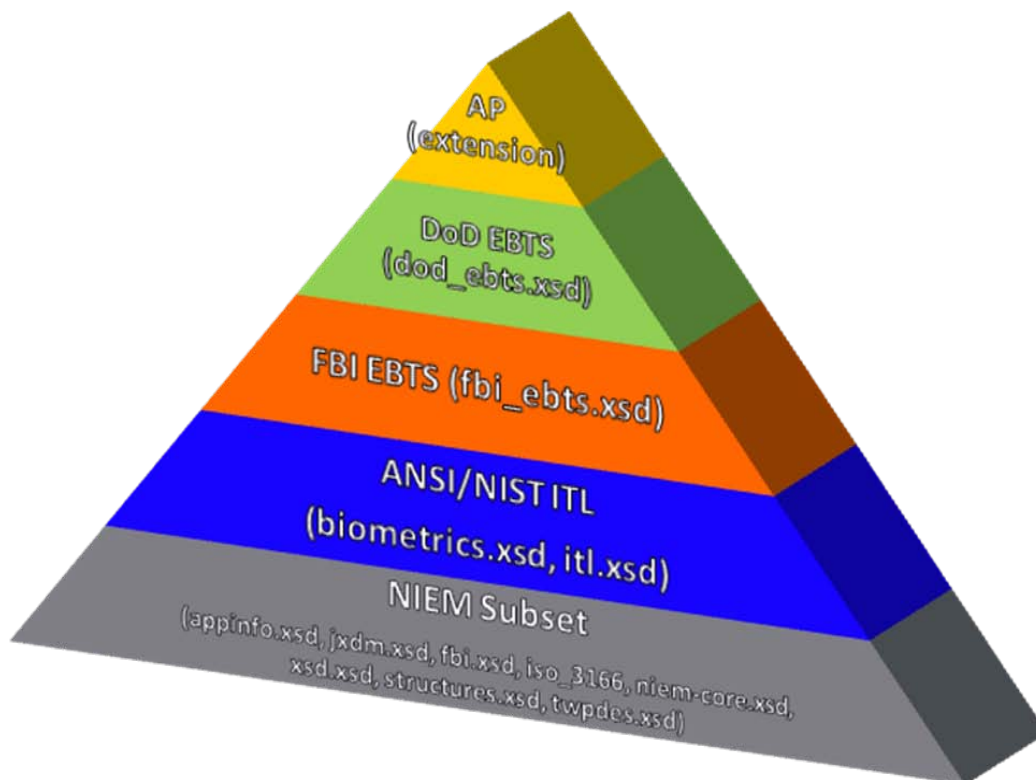
Figure 1 - Schema Relationships

The NIEM subset forms the foundation for DoD EBTS 3.0 XML schema and all of the other schemas it relies on. The NIEM subset contains NIEM reference schemas and NIEM domain schemas. The subset is described more fully in section 2.2.1.

2.1.1   NIEM Subset Schema

Only a small part of the NIEM schemas are needed to implement DoD EBTS information exchange. Reduced versions of NIEM schemas containing a subset of elements and types needed for support are provided in this IEPD. Using the provided subset schemas reduces complexity and promotes application processing efficiency.

The NIEM subset schemas are stored in the `xsd\niem` folder of this IEPD. This directory includes folders for NIEM reference schema and domain schema files. The following schemas are included in the `xsd\niem` folder:

- `appinfo\2.0\appinfo.xsd`
- `domains\`
    `biometrics\1.0\`

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```
        biometrics.xsd
      jxdm\4.1\jxdm.xsd
```
  – `fbi\2.0\fbi.xsd`
  – `iso_1366\2.0\iso_3166.xsd`
  – `niem-core\2.0\niem-core.xsd`
  – `proxy\xsd\2.0\xsd.xsd`
  – `structures\2.0\structures.xsd`
  – `twpdes\2.0\twpdes.xsd`

2.1.2   Exchange Schema

The exchange schemas are stored in the `xsd\` folder of this IEPD. The `itl.xsd` exchange schema contains NIEM-conformant types and elements defined in the 2011 version of the American National Standards Institute (ANSI) and National Institute of Standards and Technology (NIST) "Data Format for the Interchange of Fingerprint, Facial, & Other Biometric Information" [1] standard.

The following exchange schema is included in the `xsd\` folder:

  – `itl\2011\itl.xsd`

2.1.3   Extension Schema

The DoD EBTS schema defines requirements for exchanging biometric information in electronic format within the U.S. Department of Defense. The `dod_ebts` schema is based on requirements for logical record and field formats defined in the ANSI/NIST ITL standard, and requirements defined in the Department of Justice (DOJ) and Federal Bureau of Investigation (FBI) Criminal Justice Information Services (CJIS) EBTS standard [3]. Additional requirements needed to perform the mission and achieve the goals of the DoD are also contained in this IEPD.

The following extension schemas are included in the `xsd\` folder:

  – `dod_ebts\1.0\dod_ebts.xsd`
  – `fbi_ebts\3.0\fbi_ebts.xsd`

2.2   XML Instance Documents

To facilitate the development of DoD EBTS XML instance documents and messages, sample XML instances and templates are provided in the `xml\` folder of this IEPD. These examples illustrate how particular DoD EBTS transactions can be constructed.

The following samples and templates are included in the `xml\` folder:

  – `SMPL(CAR)CriminalTenprintSubmission`

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- SMPL(CNA)CriminalTenprintSubmissionNoAnswer
- SMPL(CPDR)CriminalFingerprintDirectRoute
- SMPL(DEK)DeceasedKnown
- SMPL(DEU)DeceasedUnknown
- SMPL(DPRS)DoDFlatPrintRapSheetSearch
- SMPL(ERRL)LatentTransactionError
- SMPL(ERRT)TenprintTransactionError
- SMPL(LFFS)LatentFrictionRidgeFeaturesSearch
- SMPL(LFIS)LatentFrictionRidgeImageSearch
- SMPL(MAP)MiscellaneousApplicant
- SMPL(RPSR)RapidPrintImageSearchResponse
- SMPL(SRE)SubmissionResultsElectronic
- SMPL(SRL)SearchResultsLatent
- SMPL(TPRR)TenprintRapsheetResponse
- SMPL(TPRS)TenprintRapSheetSearch

2.3   List of Artifacts

This DoD EBTS IEP documentation contains the set of artifacts that define the structure and content of the DoD EBTS IEP. The major, normative artifacts included in this IEPD are the NIEM Subset XML schema, and the Exchange, and Extension schema described in section 2.2 of this document. The following table describes the contents of the DoD IEPD:

#	Artifact	File Name	Version
1	Catalog	catalog.html	1.0
2	Change Log	changeLog.txt	1.0
3	IEP Documentation	DoD EBTS IEPD 1.0 [v1].pdf	1.0
4	Traditional to XML Mapping	DoD_EBTS_Mapping.pdf	1.0
5	Want List	wantlist.xml	1.0
	Subset Schemas		
6	Biometric Domain	biometrics.xsd	1.0
7	FBI	fbi.xsd	2.0

8	ISO 3166 Country Codes	iso_3166.xsd	2.0
9	JXDM Domain	jxdm.xsd	4.1
10	NIEM Application Information	appinfo.xsd	2.0
11	NIEM Core	niem-core.xsd	2.0
12	NIEM Proxy	xsd.xsd	2.0
13	NIEM Structures	structures.xsd	2.0
14	TWPDES	twpdes.xsd	2.0
Extension Schemas			
15	DoD EBTS	dod_ebts.xsd	1.0
16	FBI EBTS	fbi_ebts.xsd	3.0
Exchange Schemas			
17	ANSI/NIST-ITL 1-2011	itl.xsd	2011
XML Instance Documents and Templates			
18	Samples[2]	SMPL(CAR)CriminalTenprintSubmission SMPL(CNA)CriminalTenprintSubmissionNoAnswer SMPL(CPDR)CriminalFingerprintDirectRoute SMPL(DEK)DeceasedKnown SMPL(DEU)DeceasedUnknown SMPL(DPRS)DoDFlatPrintRapSheetSearch SMPL(ERRL)LatentTransactionError SMPL(ERRT)TenprintTransactionError SMPL(LFFS)LatentFrictionRidgeFeaturesSearch SMPL(LFIS)LatentFrictionRidgeImageSearch SMPL(MAP)MiscellaneousApplicant SMPL(RPSR)RapidPrintImageSearchResponse	1.0

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[2] These instance documents are for example purposes only and are not intended to represent actual transactions. Real biometric data is not used, and any names and biographic information are intended to refer only to fictional persons.

		SMPL(SRE)SubmissionResultsElectronic SMPL(SRL)SearchResultsLatent SMPL(TPRR)TenprintRapSheetResponse SMPL(TPRS)TenprintRapSheetSearch	
	NIEM Metadata		
19	Metadata XML Markup	metadata.xml	1.0
20	XML Markup Transformation	metadata.xsl	1.0
21	HTML Rendering	bima.css	1.0
22	HTML Display	images/	1.0

2.4   Prefix Namespace Descriptions

This IEPD incorporates multiple markup vocabularies. It is intended that these vocabularies will be used together in XML documents. Each vocabulary is assigned a unique namespace [9] prefix to fully qualify its element and attribute names and differentiate these names from those found in other vocabularies.

Prefix	Namespace	Description
biom	http://niem.gov/niem/biometrics/1.0	ANSI/NIST Fingerprint and Biometrics standard
dod-ebts	http://biometric.dod.mil/dod-ebts/1.0	DoD EBTS data type and complex contents extensions
ebts	http://cjis.fbi.gov/fbi_ebts/3.0	FBI EBTS extensions
fbi	http://niem.gov/niem/fbi/2.0	FBI code lists for National Crime and Information Center (NCIC-2000), National Incident-Based Reporting System (NIBRS), and National Law Enforcement Data Exchange (N-DEx)
i	http://niem.gov/niem/appinfo/2.0	NIEM application information schema for creating types

iso_3166	http://niem.gov/niem/iso_3166/2.0	Codes for the representation of names of countries and their subdivisions from the International Organization for Standardization (ISO) 3166-1:1997
itl	http://biometrics.nist.gov/standard/2011	ANSI/NIST ITL 2011 Biometric Information Exchange Data Model
j	http://niem.gov/niem/domains/jxdm/4.1	Department of Justice (DOJ) base Justice Exchange information
nc	http://niem.gov/niem/niem-core/2.0	NIEM Core includes both Universal (U) and Common (C) components. The identities for U and C components in Core are maintained with metadata
niem-xsd	http://niem.gov/niem/proxy/xsd/2.0	The NIEM distribution proxy schema provides complex type bases for some of the simple types in the XML Schema namespace
s	http://niem.gov/niem/structures/2.0	Schema constructs for use by NIEM-conformant schemas to provide consistent definitions and functionality
twpdes	http://niem.gov/niem/twpdes/2.0	Terrorist Watchlist Person Data Exchange Standard (TWPDES) [12] containing TWPDES code lists
xsd	http://www.w3.org/2001/XMLSchema	The XML Schema namespace

2.5   Traditional to XML Mappings

Traditional format DoD EBTS field identifiers, names and mnemonics are mapped to DoD EBTS XML elements in a spreadsheet provided in this IEPD. These traditional to XML mappings are stored in the `docs\` folder in the following file:

   DoD_EBTS_Mapping.pdf

This table associates the data fields in traditional EBTS encoding to their corresponding XML elements in a format that is easily searched and sorted. Values of the `minOccurs` and `maxOccurs` attributes of the elements are listed. Each XML element in the table is fully qualified by one of the namespace prefixes described in the table in section 2.6 of this document.

2.6   Application Profile

The DoD EBTS standard defines an application profile. This document uses Integrated Data Dictionary [6] (IDD) elements to fully describe the unique requirements of a particular operational environment. These requirements should include data transfer requirements, and the formats of transfer data that are acceptable. By creating an application profile, adopters of the standard can subset or extend the DoD EBTS schema (`dod_ebts.xsd`) to meet their operational needs.

An application profile can specify the conformance requirements of a DoD EBTS implementation to improve the likelihood of interoperable applications. Once an application profile is approved by BIMA, new content can be added to extend the DoD EBTS schema. User defined application profiles can also be used to provide additional schema constraints.

A base application profile is provided on the BIMA public web site [2]. This document serves as a useful example of an approved profile. Application profile-based XML instance documents must validate against the DoD EBTS schema and any user defined elements and constraints.

Constraint schemas in an application profile can further restrict the DoD EBTS schema. User defined constraints must conform to all NIEM Naming and Design Rules [7] requirements. They may only further restrict DoD EBTS defined components. They may not be used to relax DoD EBTS restrictions.

2.7   XML Structure

The DoD EBTS IEPD V1.0 is built according to the DoD EBTS 3.0 specification. It references the same base standards as the main specification does (i.e. ANSI/NIST ITL 1-2011 and FBI EBTS 9.3) with the added subset schemas from the NIEM V2.1.

DoD EBTS XML elements are placed inside the container, `DoDDefinedDescriptiveDetail`. This is analogous to the DoD EBTS 3.0 assigning the DoD IDs within the 8000 range for the Traditional Encoding.

The DoD EBTS XML schema references the same FBI EBTS elements as the main specification does. However, when the FBI EBTS element(s) do not satisfy DoD's operational need, DoD XML element(s) are created within the DoD container. The DoD element(s) shall be used for all DoD transactions. Those FBI element(s) are than treated as "Legacy Derivable". The FBI element(s) should only be used when exchanging directly with FBI. They can be derived from the DoD element(s).

The figure below illustrates, on the left hand side, the structure of a DoD XML instance document based on the DoD EBTS IEPD V1.0. On the right hand side, it illustrates the structure of a DoD XML instance document for the exchange with FBI with the same schemas. Those relevant FBI legacy derivable fields will need to be mapped and/or transformed into the FBI elements within the FBI container. The rest of the instance document can be left in place, as is, without any additional transformation.

	DoD EBTS			FBI EBTS	
Namespace Prefix	Container	Usage	Namespace Prefix	Container	Mapping Notes
ebts	DomainDefinedDescriptiveFields	FBI EBTS fields used by DoD EBTS	ebts	DomainDefinedDescriptiveFields	leave in place
	DoDDefinedDescriptiveDetail	All DoD Fields		DoDDefinedDescriptiveDetail	leave in place
dod-ebts	DoDEBTSDefinedDescriptiveDetail	DoD EBTS specific fields			map/transform relavent *legacy* fields to FBI container
<AP - assigned by BIMA>	<AP - assigned by BIMA>	DoD Application Profile fields			leave in place

Figure 2 - DoD to FBI Mapping

3   NIEM Conformance

The NIEM information exchange reference model is not a strict standard against which conformance is easily measured. All parts of the NIEM need not be used in a given IEPD for that IEPD to conform to NIEM requirements. Even the NIEM Conformance Validation tool is not "the authoritative source for NIEM conformance", and therefore, cannot "guarantee or be used to certify full NIEM conformance" [8].

NIEM conformance rules were followed during the development of this DoD EBTS IEPD. These rules served as guidelines for achieving our goal of creating a common, unambiguous understanding of biometric information that could be shared across the DoD and with its information exchange partners.

This DoD EBTS IEPD conforms to the following NIEM conformance rules and guidance:

- All instances are XML valid and validate against all NIEM reference schemas used

- All IEPD schemas import and reference required NIEM namespaces [9]

- Where appropriate, existing NIEM components (e.g., types, elements, attributes, etc.) were used

- All NIEM components were used in accordance with their definitions

- All required artifacts have been defined and provided following the NIEM IEPD Lifecycle

- All schema components adhere to the NIEM Naming and Design Rules (NDR)

4   Contact

If you require technical assistance, please contact the ABIS Watch Desk by telephone at +1 (304) 326-3024 or send electronic mail to watchdesk@abis.biometrics.mil.

For assistance with the DoD EBTS standard or the DoD EBTS Application Profile approval process, please send electronic mail to DCSG-3BiometricsStandardsBranchTeam@conus.army.mil.

Appendix A

A.1. Optional Validation and Transfer

DoD EBTS 3.0 defines an XML schema (`dod-ebts`) for information exchange and transmission. This schema allows DoD and its partner agencies to share biometric data. When the standard is implemented, derivatives of the `dod-ebts` schema can be used to achieve more efficient XML validation and data transfer.

Biometric data, such as fingerprint images, are typically stored and processed in a binary format. For use in XML documents, the `dod-ebts` schema defines images in a verbose, character string format known as Base64 [11]. Base64 encoding of binary images causes their size to increase by some 33%. Larger images require more storage and transmission time, and computing resources must be used to convert images between binary and string formats.

For images in character string format, transfer size and time can be reduced by using the XML-binary Optimized Packaging (XOP) standard [14]. XOP transfers images in their binary format, while XML instance documents that conform to the `dod-ebts` schema must contain images in their string format. However, document images still must be converted from binary to string format for validation against the `dod-ebts` schema.

Systems that use XOP must be capable of processing multipart messages and recognizing the headers that separate message parts, making XOP unsuitable for some environments. XML validation efficiency still suffers when tools must process large amounts of unstructured Base64 images to validate an XML document against the `dod-ebts` XML schema. The use of XOP addresses image transfer efficiency. XOP use alone does not address the processing required to convert images between binary and string formats, or the need to efficiently validate instance documents.

An alternative to XOP that does address these concerns is to use a derivative schema that supports both binary and XML markup formats of EBTS documents. These formats are based on the X.694 standard [13]. Two formats allow an XML document to be transferred and validated in a compact binary form that is then presented to a recipient as the initial XML document.

To enable this approach, the `dod-ebts` XML schema can be translated into an analogous ASN.1 schema based on the mapping defined in X.694. Once a schema mapping has been created, the ASN.1 encoding rules can be used to transfer DoD EBTS documents in binary and XML markup formats. The XML documents produced using a derived ASN.1 schema will be valid `dod-ebts` documents.

A.2. How ASN.1 Works

Every XML schema has an analogous ASN.1 schema. A derivative ASN.1 schema can be used to represent DoD EBTS instance document values in both binary and XML markup formats. Using an

ASN.1 schema allows data to be transferred in a compact binary message, which can then be presented to the recipient as XML markup. Schema validation can be performed faster against an ASN.1 schema, since binary versions of instance documents are smaller, and large opaque data elements, such as fingerprints, can be quickly skipped over rather than being processed serially, character by character.

The process of creating an ASN.1 derivative of the DoD EBTS schema is illustrated in the following graphic:
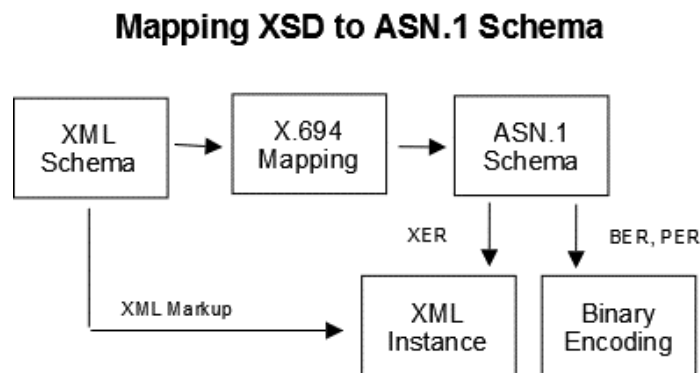
Mapping XSD to ASN.1 Schema

Figure 3 - Schema Mapping

The X.694 standard can be applied one time to map the DoD EBTS schema into a derivative ASN.1 schema. The mapping provided by X.694 allows applications that use generated ASN.1 encoding tools to produce XML-valid DoD EBTS instance documents, or compact binary versions of those documents. Both of these document formats can be transferred in the simple, single part messages as required by some systems.

A.3. An ASN.1 Derivative Schema

The DoD EBTS schema can be translated directly into an analogous ASN.1 schema to enable fast binary schema validation and compact data transfer. No changes to the DoD EBTS schema are required. The DoD EBTS schemas can be translated by hand, or used as inputs to automatic XML to ASN.1 schema translation tools.

The resulting ASN.1 DoD EBTS schema can be used as input to computer programming language (e.g., C, C++, C#, Java, etc.) code generation tools. The generated programming language code can then be used to build DoD EBTS applications that can process DoD EBTS documents in binary and XML markup formats. These applications will be capable of creating binary versions of DoD EBTS XML instance documents, and creating valid DoD EBTS XML instance documents from these binary message formats.

A.4. How XOP Works

The XOP process used to send information in a multipart message is illustrated in the following graphic:
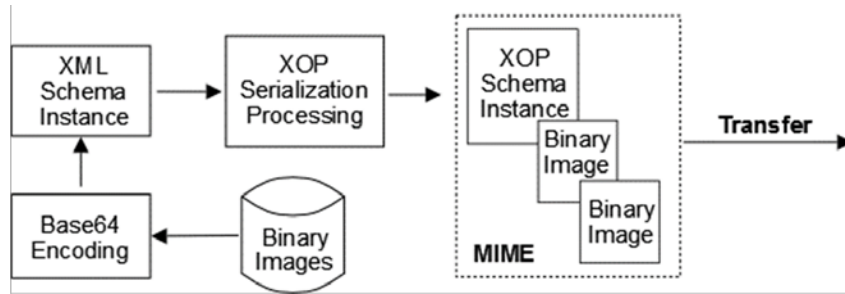
Figure 4 - General XOP Send

In an XML document that conforms to the `dod-ebts` schema, a binary image is represented as a Base64 character string. After a DoD EBTS 3.0 document is constructed by a message sender, it is validated against the `dod-ebts` schema. If the document is valid, it is transmitted to a message recipient.

During this transmission phase, XOP serialization occurs. XOP strips the document being sent of its character string images and replaces them with `xop:Include` elements. In the `dod-ebts` schema all character string images defined as type `nc:BinaryBase64Object` are replaced by the XOP serialization process. The `xop:Include` elements contain hypertext references (pointers) to the replaced images, and have the following form:

```
<Base64CharacterStringImage>
   <xop:Include xmlns:xop='http://www.w3.org/2004/08/xop/include'
       href='cid:http://biometrics.dod.mil/fingerprint.jpg'/>
</Base64CharacterStringImage>
```

A.5. An XOP Derivative Schema

XOP can then transmit the EBTS document efficiently in a message composed of multiple parts (e.g., a Multipurpose Internet Mail Extension, or MIME message). The main or root part of the MIME message is shown in Figure 4 as the *XOP Schema Instance*. This XML document contains a stripped down DoD EBTS 3.0 document. This document no longer conforms to the `dod-ebts` schema. A set of binary images are included in the other parts of the MIME message.

This XML document now conforms to a derivative of the `dod-ebts` schema, a XOP-DoD EBTS 3.0 schema. The other MIME parts are composed of the binary images pointed to from within the XML part. These images are converted into binary for transmission by XOP from the Base64 string images found in the initial DoD EBTS 3.0 XML document.
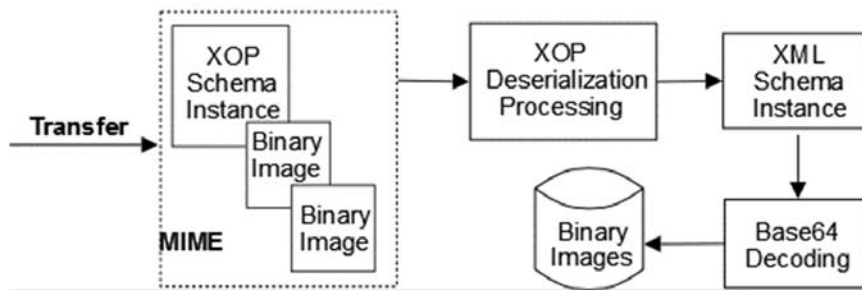
Figure 5 - General XOP Receive

As shown in Figure 5, to determine if a message is valid, the recipient must first reconstruct the initial DoD EBTS 3.0 XML document and validate that document against the `dod-ebts` schema. This process requires XOP Deserialization, the process of converting each binary image in the MIME message back into its Base64 string format.

Message recipients must agree to accept this transmission format, since XOP messages do not conform to the `dod-ebts` schema. They conform to a derivative of that schema. Following the `dod-ebts` schema, recipients would expect a single part message containing character string images. They would not expect a multiple part MIME message containing binary images.

DoD EBTS 3.0 defines a single `dod-ebts` schema for information exchange and message transmission. Users of the standard can create and use a derivative of the `dod-ebts` schema for more efficient data transfer and XML document validation. This derivative `xop-dod-ebts` schema should be capable of supporting the following optimized XOP transmission process:
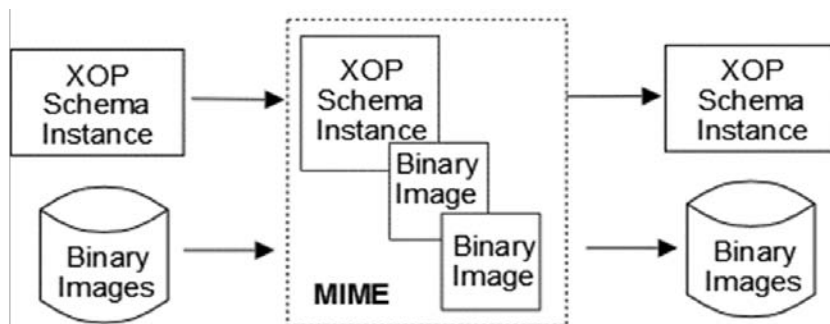

Figure 6 - Optimized XOP Transfer

This process conforms to the XOP standard. By using a derivative schema optimized for transfer, the sender is not required to create character string images, or to convert these images into binary for MIME transmission, then back into Base64 strings for XML validation. Message recipients could use either the derivative schema or the `dod-ebts` schema for message validation. However, using the derivative schema for validation is more efficient, since only short image references rather than large Base64 string images need to be processed.

Abbreviations and Acronyms

TERM	DEFINITION
ANSI	American National Standards Institute
ASN.1	Abstract Syntax Notation One
BIMA	Biometrics Identity Management Agency
CJIS	Criminal Justice Information Services
DoD	Department of Defense
DOJ	Department of Justice
EBTS	Electronic Biometric Transmission Specification
FBI	Federal Bureau of Investigation
HSPD	Homeland Security Presidential Directive
IDD	Integrated Data Dictionary
IEP	Information Exchange Package
IEPD	Information Exchange Package Documentation
ITL	Information Technology Laboratory
MIME	Multipart Internet Mail Extension
N-DEx	National Law Enforcement Data Exchange
NIEM	National Information Exchange Model
NIST	National Institute of Standards and Technology
TWPDES	Terrorist Watchlist Person Data Exchange Standard
U.S.	United States
XML	Extensible Markup Language
XOP	XML-binary Optimized Packaging

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