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# **Business Document Format Choices for Health E-Procurement**

## **A Final Evaluation**

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# Executive Summary

This document surveys the most common business document formats for E-Procurement. It specifies a number of mandatory, and a number of preferential criteria by which the different formatting standards are to be evaluated. Firstly a number of candidate standards are eliminated, as they do not meet one or more of the mandatory criteria. Then ratings are applied to the preferential criteria for each of the remaining candidates. The criteria are then weighted for relevance, and total rating scores are calculated. Finally a conclusion is drawn about the most appropriate standard for the format of business documents in NEHTA E-Procurement messaging. The document format that best meets the criteria is GS1 XML.

# 1 Introduction

## 1.1 Purpose

This paper discusses the options for different document formats for Electronic Procurement for Health. Its purpose is to arrive at a shortlist or choice of suitable standards to represent the five document types nominated in the E-Procurement Business Architecture. This document replaces the Preliminary Evaluation (Version 1.6) paper, which has been updated to include new information on forthcoming document formats, and now includes two additional preferential criteria for evaluation, as requested in feedback from jurisdictions.

## 1.2 Background

### 1.2.1 EDI

Before the internet was widely available to business and government, electronic information exchange was known as Electronic Data Interchange (EDI). EDI defined electronic versions of procurement, logistical and financial business documents. Document exchange was done through dialup connections using proprietary networking, or via leased lines. Modems and leased lines were very expensive, and there was no equivalent of modern internet addressing and routing. In Australia the partners in EDI needed to subscribe to one of three available Value Added Networks (VANs), provided by Telecom, GE or AAPT. The VANs' service was merely to store and forward EDI documents that were of an agreed format, between buyer and seller. In the late 1970s national and international standards efforts sought to provide uniformity to the documents. In the USA the American National Standards Institute (ANSI) published EDI document formats known as X.12 [X12], and internationally EDI formats were standardised under the United Nations Centre for Trade Facilitation and Electronic Business as UN/EDIFACT (United Nations/Electronic Data Interchange For Administration, Commerce, and Transport) [EDIFACT-UN].

EDI continues to this day. In Australia the predominant EDI standard is EANCOM, published by GS1 [EANCOM]. Its use is driven largely by the large retailers, Coles Myer and Woolworths. Although the leased lines have been replaced by internet connections, the document formats used for interchange are still in wide usage. VANs have evolved to offer internet protocol support, additional services, and support for newer document formats.

### 1.2.2 Internet and B2B

In the mid to late 1990s when the internet was becoming a more established networking environment within organisations, there were several updates to the EDI paradigm. Firstly, the internet protocol for email, Simple Mail Transfer Protocol (SMTP), and the File Transfer Protocol (FTP) came to be used to transfer EDI documents directly between parties connected to the internet. Later, once the World Wide Web and its transfer protocol, the Hyper-Text Transfer Protocol (HTTP), was popularised, this became another mechanism for EDI document transfer.

In the later 1990s a new self-describing format, eXtensible Markup Language (XML), that was an extension on the now-popular web formatting language Hypertext Markup Language (HTML), became popular for describing any kind of data that could be exchanged on the internet. The relative human readability of XML compared to the obfuscated formatting of other electronic documents, like EDI, made it a popular basis for the reinvention of all sorts of computer-exchanged data. Among the many new XML-based formats being

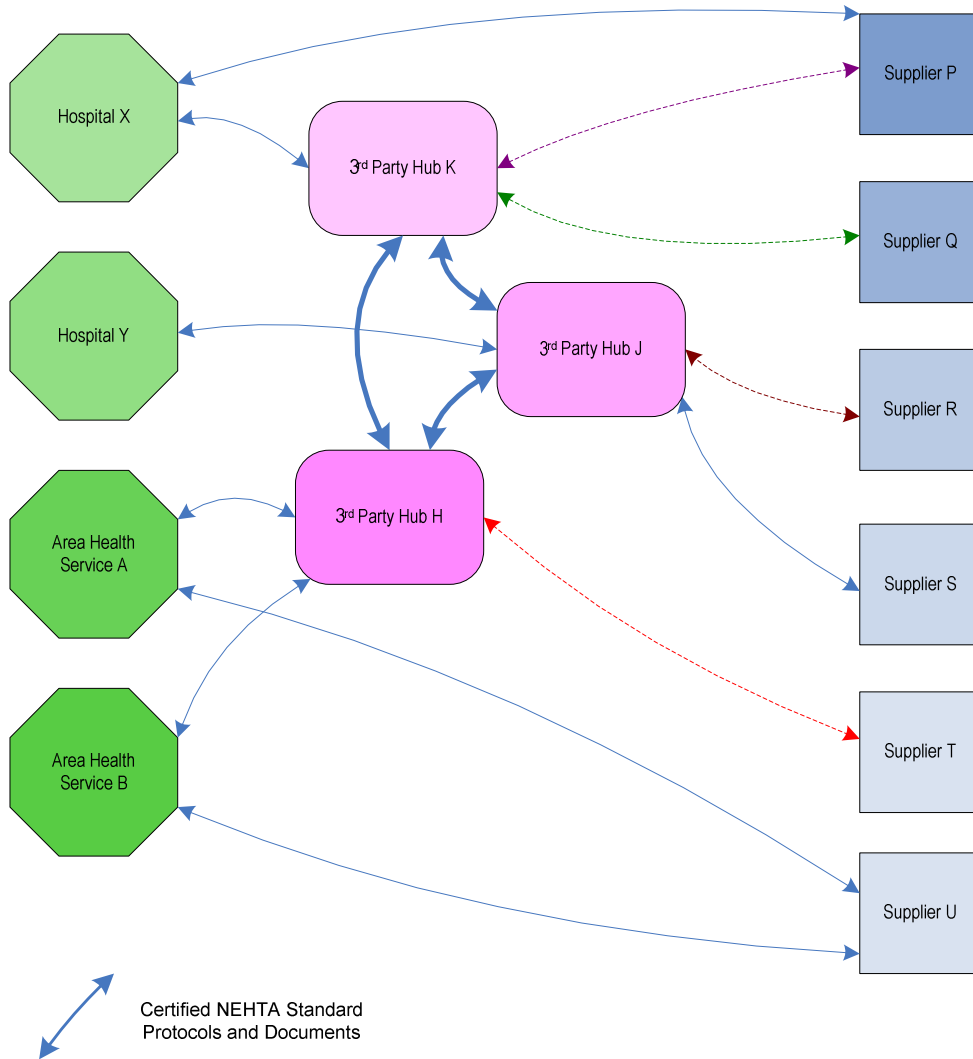
defined in the late 90s was something called Business to Business documents, or B2B. Although the possible scope of B2B was very broad, the perceived "easy target" documents to be defined included those that were already being exchanged as EDI; namely e-procurement business documents.

Among the slew of competing B2B standards were Rosettanet, electronic business for XML – ebXML, and OpenBuy. Each used the internet's communications protocols with XML to achieve the transmission back and forth of business documents between business partners, including buyers, sellers, shipping agents and financial institutions.

Perhaps the greatest innovation of these approaches was the practice of associating a public business process with the documents, and using *enveloping* to enclose the XML business document within a wrapper that contained the public business process context, formatting information about the encapsulated business document, as well as sender and receiver information, among other things. This rich transaction data allowed for a very flexible delivery model for business documents. They could be sent directly between business partners in a format understood by both, or they could be sent via a number of possible intermediaries, which could forward the message, or translate its contents, or perform other actions based on the information in the envelope header.

### **1.3 Usage Context**

The NEHTA Secure Messaging Architecture [WSSP2006, TAIS2006] will form the basis of service interface design, and technical transport mechanism for E-Procurement. This Architecture has chosen Web Services and SOA as the basis for data transmission.



**Figure 1: E-Procurement Architecture**

Figure 1 shows the possible range of message delivery options from buyers (green octagons) to and from their suppliers (blue squares). Messages may be sent directly from buyers to suppliers, or they may be delivered via an e-procurement hub, or via more than one hub. The thicker lines denote hub interconnection. Note that in most cases only communications between the buyers and the parties they connect to, and between hubs are expected to be standardised (denoted by solid blue lines). Most communication from hubs to suppliers will be tailored to meet the suppliers' needs (denoted by dashed lines in other colours). Therefore any standard for documents that is published is mandatory only for buyers and hubs. Whilst the selected standard will also be suitable for suppliers who currently do not implement E-Procurement, it is not intended to be mandated for use by all suppliers, as many already implement messaging in some other format.



## 2 Criteria for Selection of a Format

The following criteria will be applied to a number of candidate document formats. There are two kinds of criteria, the first kind is mandatory, and the second is preferential. Mandatory criteria must be met in order for a format to be acceptable, and preferential criteria allow for a weighted rating to be made for each format to lead to a score.

The two mandatory criteria are:

- A. Compatible with AS5023 [HSCM2004]
- B. Conforms to Secure Messaging Architecture [WSSP2006, TAIS2006]

The remaining criteria, in order of importance are:

1. Well designed
2. Well documented
3. Easily and inexpensively implementable by jurisdictions and hubs
4. Suitable for multiple delivery location per line item ordering
5. Compatible with the National Product Catalogue
6. Published by an international standards organisation

Some explanation of each criterion follows.

### Criterion A: Compatible with AS5023

The Australian Standard for Health Supply Chain Messaging [HSCM2004] has been developed by Standards Australia, and endorsed as a business-level interoperability standard by the jurisdictions. Therefore any technical document format to be selected for health supply chain messaging (e-procurement) must be able to represent the five documents nominated in the NEHTA E-Procurement Business Architecture [EPBA2007], namely: Purchase Order, Purchase Order Response, Purchase Order Change, Despatch Advice and Invoice. It is also important that technical formats for representing these standard documents deal with all of the pertinent fields specified in the Health Supply Chain Data Sets.

### Criterion B: Conforms to Secure Messaging Architecture

It must be possible for technical representations of e-procurement documents to be transferred as part of a Web Services invocation using the NEHTA Web Services Standards Profile [WSSP2006]. Although this allows arbitrary binary data and documents to be opaquely transmitted, well-formed Web Services invocations use XML payloads.

### Criterion 1: Well designed

The format for procurement documents should use a consistent structure, with meaningful names for data fields. It should reuse common structural types, and should allow for meaningful representation of codes, quantities, units and the like. It should preferably conform to a set of best-practice methodology and design rules, for example that proposed by GovDex [GOVDX2007] or the UN/CEFACT Modelling Methodology [UMM].

## **Criterion 2: Well documented**

The standard explaining the format should be as well structured and complete as the syntactic description of the documents themselves. It should explain the purpose and semantics of all data fields and reusable types. It should provide meaningful example instances of documents that conform to the standard.

## **Criterion 3: Easily and inexpensively implementable by jurisdictions and hubs**

This criterion is perhaps the most subjective, and difficult to ascertain. This is due mostly to the diversity of systems platforms used within the jurisdictions and hubs. However ease of use can be characterised as the ability for the greatest range of software professionals to be able to understand the formats and their technical realisation. The expense part of this criterion will be affected by the use of open standards, and commonly available toolsets for manipulating the formats to be used.

## **Criterion 4: Suitable for multiple delivery location per line item ordering**

The ability to specify several ship-to locations for a single purchase order line item is a requirement for ordering within NSW Health, and was proposed by NSW Health as an evaluation criterion. It may also be useful in other jurisdictions, in particular WA, where ordering is consolidated centrally for like products from orders originating in different locations. It specifically requires that a line item in a Purchase Order (or Purchase Order Change, or Purchase Order Acknowledgement) can be split into parts for delivery to multiple locations.

## **Criterion 5: Compatible with the National Product Catalogue**

By the end of 2007 the NEHTA National Product Catalogue will be based on XML messaging using the Global Data Synchronisation Network (GDSN) standards. All jurisdictions will need to deal directly or indirectly with product and pricing data which is formatted according to the GS1 GDSN XML standard. This criterion rates the potential e-procurement document formats for compatibility with this standard.

## **Criterion 6: Published by an international standards organisation**

The standard should not be proprietary, should be free to use without restrictive licensing, and should be published by a not-for-profit Standards Development Organisation.

## 3 Candidate Standards

The following standards specify technical formats for e-procurement documents:

- EDIFACT
- X.12
- EANCOM
- xCBL
- UBL
- cXML
- GS1 XML
- OAGIS 7.2.1
- OAGIS 9.0

There are others, but this list covers the 3 mainstream EDI formats, and the 5 commonest XML-based standards.

### 3.1 EDIFACT

EDIFACT – the Electronic Data Interchange For Administration, Commerce and Transport – is a standard of the United Nations [EDIFACT-UN]. It is standardised by UN/CEFACT, the *United Nations Centre for Trade Facilitation and Electronic Business* under the UN Economic Commission for Europe. EDIFACT has also been standardised by the International Standards Organisation as ISO 9735. It is a plain-text, quote-delimited format, and is one of the two main EDI standards. There are hundreds of documents types specified, including all of those required by the NEHTA E-Procurement Architecture. EDIFACT is used mainly in Europe, whereas the other prominent EDI standard, X12 is used mainly in the United States.

### 3.2 X12

X12 is the American National Standards Institute (ANSI) standard for EDI. The standard x12.6 is the formatting standard for business documents. A recent stable release of X12 is known as release 004010. The body within ANSI that standardises X12 is called ANSI Accredited Standards Committee (ASC) X12 [X12-2007]. It is not freely available for download, and must be purchased from the Data Interchange Standards Association. Business documents are known as Transaction Sets, and have unique numbers, for example, 850 is Purchase Order and 810 is Invoice [X12-UTEX]. There are hundreds of document types for a range of industries' data interchange needs.

### 3.3 EANCOM

EANCOM is the Global Standards One (GS1) EDI standard. It is the standard used widely in the Australian grocery industry, and although GS1 is not a *de jure* standards body, it is a not-for profit organisation which has wide acceptance as an honest broker. EANCOM is a subset of the UN/EDIFACT messages with additional guidelines for implementers. It provides good integration with the EAN bar coding standards, also published by GS1 [EANCOM]. Documents describing formats for business documents are known as Message Implementation Guidelines (MIGs), and are freely available from GS1. They are tailored for use by GS1 national offices in each country in cooperation with local industry users.

### 3.4 xCBL

xCBL stands for XML Common Business Library [XCBL2000, COVER2001]. It is published for royalty-free use by Commerce One, which as of early 2006 is a subsidiary of Perfect Commerce. Perfect Commerce's intentions for its new acquisition are unknown. Its latest version, 4.0, is published as a set of XML Schema files. It was originally based on existing EDI standards, but has been redesigned in its transition from XML DTD to XML Schema. It contains definitions of 44 business documents, covering all of the documents specified in the NEHTA E-Procurement Architecture. xCBL was the basis of standardisation of the UBL document set, and the publishers of xCBL have a commitment to migrate towards UBL document types for future versions of the xCBL standard [XCBL2000].

### 3.5 UBL

Universal Business Language (UBL) is published by the Organization for the Advancement of Structured Information Standards (OASIS) [OASIS2007], a global *de facto* standards organisation, which is a consortium of businesses and other organisations [UBL-FAQ]. It is most well known for its development, with UN/CEFACT, of eBXML – a standard for XML-based E-Commerce. UBL is the subset of the eBXML standards that defines business documents, and is developed using the UN/CEFACT Modelling Methodology (UMM) [UMM], and the UN/CEFACT/ISO Core Components Technical Specification. UBL 2.0 is the latest version of the standard. It is extensible, using the UMM where required, to suit national or industry requirements. UBL is most famously implemented as the mandatory format in which all invoices to the Danish government must be transmitted, with paper documents no longer accepted.

### 3.6 cXML

CXML.org offers the cXML XML DTDs for free download and use, but there is little information about the organisation and processes through which the DTDs have been developed. The cXML Web site reveals that Ariba, an e-commerce solutions company in the United States, drives changes to the published DTDs and that it is a closed industry consortium which is not open to new members. The current version of cXML is 1.2.016 [CXML].

### 3.7 GS1 XML

GS1, which publishes EANCOM, also recognises that XML is an increasingly popular format for electronic documents, and has produced a set of XML Schemas to parallel its EDI standards [GS1-XML]. These are designed using a predecessor of the UMM.

### 3.8 OAGIS 7.2.1

OAGIS is the e-commerce standard published by the Open Applications Group – a not-for-profit industry consortium which acts as an open *de facto* standards organisation [OAG2007]. It is a member of both WSI (Web Services Interoperability – another industry consortium), and OASIS. The OAGIS standards have been in development over 10 years. They use Business Object Documents (BODs) which combine a verb (such as "process") with nouns (such as "Invoice") to produce documents for use in a particular context. The 7.2.1 version of the BOD standards are defined using XML DTDs [OAGIS-7], and are in use in Oracle 11i (the most widely deployed ERP system in the state and territory Health Departments) – although the implementation in Oracle is far from conformant to the standard.

### **3.9 OAGIS 9.0**

OAGIS version 9.0 is the latest release of the OAG standard, and has been redesigned using the UN/CEFACT/ISO Core Components Technical Specification, CCTS 2.01. It is expressed as a set of XML Schema documents, which cover all of the document types required by the NEHTA E-Procurement Architecture [OAGIS-9].

## 4 Application of the Mandatory Criteria

In the case of criteria A and B above, failure to meet the criteria will eliminate the approach from contention as a possible standard for NEHTA E-Procurement.

### 4.1 Compatibility with AS5023

The ability to represent all relevant fields of the datasets specified in the Australian Supply Chain Health Messaging standard, AS5023, is also a non-negotiable requirement.

**Note:** In the preliminary version of this paper, GS1 XML was eliminated for failing to provide a Purchase Order Change message. However, a standards update will now allow the GS1 XML Multi-Shipment-Order message to support the functionality of the AS 5023 Purchase Order Change data set.

### 4.2 Secure Messaging Compatibility

#### EDI

The one "showstopper" criterion that invalidates the largest number of approaches is the condition that it must conform to the NEHTA Secure Messaging Architecture. This means that the format must be usable within the context of Web Services. In short – it must be an XML format. This immediately eliminates EDIFACT, X.12 and EANCOM, leaving the XML standard: xCBL, UBL, cXML, and OAGIS.

The argument can be made that any binary format (including semi-colon separated EDI formats) can opaquely be used in the payload of a Web Services message, and that this leaves a place for EDI in the Secure Messaging Architecture. However, in consultation with the jurisdictions (the state, territory and Commonwealth Health Departments), which will implement the standard, NEHTA has determined that the requirement for an XML-based format is universal. The reasoning in most cases has to do with the status of XML as a native format for most jurisdiction's backend systems. The adoption of an EDI format as a standard would require expensive additional modules to be purchased for most of the computing platforms in use by the jurisdictions. In addition in most cases consultants would also need to be hired to configure them.

#### DTD

OAGIS 7.2.1 is under consideration because it is the format supported by default as an XML export from Oracle 11i. Although the default XML map from the internal Oracle format to OAGIS 7.2.1 uses many non-standard features, and hides data in so-called "user areas" of the XML documents, it is conceivable that this could be corrected, and possibly with the help of Oracle, which has support contracts in place with many of the jurisdictions to cover this mapping. This support, however, does not explicitly include conformance to the OAGIS standard, and Oracle could argue that all the relevant fields for the documents which the E-Procurement Architecture has nominated are included in the current map.

Version 7.2.1 of OAGIS is now some years old, and it uses the DTD format for describing the documents, whereas the Secure Messaging Architecture requires the use of XML Schema. The design of OAGIS 7.2.1, including its use of identifiers, and its documentation and example instances, are of low quality. Additionally, this version of OAGIS is no longer current, and differs substantially from the current version. The wisdom of adopting a deprecated

standard which is no longer the focus of standardisation efforts, and standards community support is also questionable.

On this basis the cXML standard is also eliminated as it only uses DTD as well. The standard also makes the choice of tying the XML to the protocol (using HTTP POST) for message transmission, which is incompatible with a Web Services approach. Although the latest user guide is dated Sept 2006, it seems that the cXML web site is also some years old (copyrighted 2000), and the HTML rendering of the page is not W3C compliant, with no metadata and not even a page title.

# 5 Evaluation of the Preferential Criteria

The following tables show the results of our evaluation of the four remaining XML candidate standards. We have evaluated the scores given to the candidate standards according to three weighting schemes.

## 5.1 Linear Decreasing Weighting of the Criteria

As stated in Section 2, the criteria are listed in decreasing order of importance. In the first weighting we assign weights of decreasing importance in a linear fashion, with each subsequent criterion worth 10% less than the previous one. This results in the following score totals.

|           |            |     |     |     |     |     |     | Total |
|-----------|------------|-----|-----|-----|-----|-----|-----|-------|
|           | Criterion  | 1   | 2   | 3   | 4   | 5   | 6   |       |
|           | Weight     | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 | 0.4 |       |
| xCBL      | Unweighted | 6   | 8   | 7   | 0   | 1   | 4   | 18.8  |
|           | Weighted   | 5.4 | 6.4 | 4.9 | 0   | 0.5 | 1.6 |       |
| UBL       | Unweighted | 9   | 9   | 8   | 10  | 4   | 8   | 32.1  |
|           | Weighted   | 8.1 | 7.2 | 5.6 | 6   | 2   | 3.2 |       |
| OAGIS 9.0 | Unweighted | 7   | 6   | 8   | 0   | 2   | 9   | 21.3  |
|           | Weighted   | 6.3 | 4.8 | 5.6 | 0   | 1   | 3.6 |       |
| GS1 XML   | Unweighted | 9   | 8   | 8   | 10  | 10  | 8   | 34.3  |
|           | Weighted   | 8.1 | 6.4 | 5.6 | 6   | 5   | 3.2 |       |

## 5.2 Stepped Decreasing Weighting of the Criteria

In the second weighting, the first three criteria, which are the most substantial in terms of standards quality, are given equal 80% weightings. The latter three criteria, which are somewhat more narrow in focus are then weighted equally at 40%. This results in the following score totals.

|           |            |     |     |     |     |     |     | Total |
|-----------|------------|-----|-----|-----|-----|-----|-----|-------|
|           | Criterion  | 1   | 2   | 3   | 4   | 5   | 6   |       |
|           | Weight     | 0.8 | 0.8 | 0.8 | 0.4 | 0.4 | 0.4 |       |
| xCBL      | Unweighted | 6   | 8   | 7   | 0   | 1   | 4   | 18.8  |
|           | Weighted   | 4.8 | 6.4 | 5.6 | 0   | 0.4 | 1.6 |       |
| UBL       | Unweighted | 9   | 9   | 8   | 10  | 4   | 8   | 29.6  |
|           | Weighted   | 7.2 | 7.2 | 6.4 | 4   | 1.6 | 3.2 |       |
| OAGIS 9.0 | Unweighted | 7   | 6   | 8   | 0   | 2   | 9   | 21.2  |
|           | Weighted   | 5.6 | 4.8 | 6.4 | 0   | 0.8 | 3.6 |       |
| GS1 XML   | Unweighted | 9   | 8   | 8   | 10  | 10  | 8   | 31.2  |
|           | Weighted   | 7.2 | 6.4 | 6.4 | 4   | 4   | 3.2 |       |

## 5.3 Unweighted Scores

For reference we also added up the total scores using unweighted criteria (equal 100% weighting for all). The following table shows the unweighted totals.



|           |            |   |   |   |    |    |   | Total |
|-----------|------------|---|---|---|----|----|---|-------|
|           | Criterion  | 1 | 2 | 3 | 4  | 5  | 6 |       |
|           | Weight     | 1 | 1 | 1 | 1  | 1  | 1 |       |
| xCBL      | Unweighted | 6 | 8 | 7 | 0  | 1  | 4 |       |
|           | Weighted   | 6 | 8 | 7 | 0  | 1  | 4 | 26    |
| UBL       | Unweighted | 9 | 9 | 8 | 10 | 4  | 8 |       |
|           | Weighted   | 9 | 9 | 8 | 10 | 4  | 8 | 48    |
| OAGIS 9.0 | Unweighted | 7 | 6 | 8 | 0  | 2  | 9 |       |
|           | Weighted   | 7 | 6 | 8 | 0  | 2  | 9 | 32    |
| GS1 XML   | Unweighted | 9 | 8 | 8 | 10 | 10 | 8 |       |
|           | Weighted   | 9 | 8 | 8 | 10 | 10 | 8 | 53    |

## 5.4 Analysis

The two weighted ratings and the unweighted totals all result in the same raking order for the four standards, namely: GS1 XML followed by UBL, OAGIS 9.0, and lastly xCBL. A number of other manipulations of the weightings also produced the same ranking order.

## 6 Conclusion

The evaluation of the potential document formats for representing the AS 5023 Health Supply Chain Messaging Data Sets was conducted by specifying two mandatory criteria which must be met by any valid candidate formats and six preferential criteria against which to allocate scores.

Several formats were excluded because they did not meet either or both of the mandatory criteria. The remaining candidates were scored out of ten against the preferential criteria. Then totals of the scores were added up using two different weighting models, as well as an unweighted model. The scores were analysed, and the ranking of the candidate formats was the same using all three weightings.

GS1 XML is the document format that meets all the mandatory criteria, and best fits the additional preferential criteria. Therefore this will be specified as the NEHTA standard technical document format for E-Procurement.

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