FeRD Forum elektronische Rechnung Deutschland

ZUGFeRD 2.1.1

Technical Supplement

Part A

(English Version)

Date of publication: July 1, 2020

Content

1. ZUGFeRD 2: Preliminary Remarks

ZUGFeRD 2 is a format for data and documents designed to foster the exchange of information both for B2B and B2G, as well as transnationally. Germany, France and Switzerland have all published user guides. The focus lies on the exchange of electronic invoices in a hybrid formats, i.e. invoices which consist of a visual and a machine-readable representation.

The format ZUGFeRD 1 was a first step into that direction within B2B. It has established itself firmly as a reliable format.

Its successor is ZUGFeRD 2, which incorporates the requirements set by the European standard EN 16931, thus levelling the different requirements within public administrations on the one hand, and the implementation of our partners in France on the other.

With ZUGFeRD 2 in its version 2.1 (short: ZF21), the goal of parity has finally been reached. The publication of ZF21 was necessary because of deviations and inconsistencies in ZUGFeRD 2 in version 2.0 (standard). This new release of ZUGFeRD in its version 2.1 eliminates all factual differences between ZUGFeRD and the French format Factur-X, with the exception of their name. Both specifications are now congruent with regard to their specification. Henceforce, their primary name space is called ***„factur-x.eu“***, thus allowing the exchange of invoices in ZUGFeRD-format across borders.

With the publication of ZF21, the name space *“zugferd.de”* as known from ZUGFeRD 2.0 will become obsolete. For reasons of legacy we shall continue to support the old name space for the time being. It will be described in a separate part of the Technical Supplement. However, we cannot foresee for how long the obsolete name space of ZF20 is going to be supported. We therefore strongly recommend realising new implementations with ZF21, in order to ensure future sustainability.

This supplement describes the implementation within the unified name space ***„factur-x.eu”***. It also shows that the effort required for necessary modifications for the transition from ZF20 to ZF21 is rather limited.

2. Generating ZUGFeRD 2.1 instance files

Within the context of bilateral agreements (e.g. for specific sectors or user groups), the specification ZUGFeRD allows for the use of different transfer formats. This applies to applications which are technically already capable of processing just the structured data as well as to the separate transfer of structured data and their visual representations (separate transfer of XML and PDF file). Such transfers lead to a multiplication of required output channels, at least for the sending systems. It is this proliferation that the hybrid invoice aims to reduce, as described below.

In this specification PDF / A-3 is defined as the carrier format. It is characterized by the following essential properties:

1. The visual representation of the invoice data (image representation) takes place via a PDF/A-3-compliant document according to ISO 19005-3 [IS19005-3]. It makes the invoice legible for humans and can be archived long-term.

2. The invoice data are embedded in the PDF/A-3 file in XML format (data representation) with reference to the entire document using a so-called File Specification Dictionary. The current version of ZUGFeRD only allows for one single invoice data document per PDF/A-3 document.

3. Principally, however, it is possible to use PDF/A-3 as a container for several files. Thus, for example, explanatory documents for invoice verification can also be embedded in PDF/A-3, as additional documents.

PDF/A-3 was selected as the carrier format for ZUGFeRD invoices because it allows for the combination of structured XML data (data representation) and their visual representation, in combination with supporting metadata in a standardised way.

In order to ensure conformity, the PDF/A-3 document must contain internally the following constructs:

- A PDF/A-3 conformant structure, i.e. the source document must be PDF/A-3 conformant even without the embedded data. The so-called conformity level (i.e. 3a, 3b or 3u) is irrelevant.

- The embedding of the XML invoice file with the specification of a corresponding relation (AF-relationship) at document level. Note: The "Alternative" relation type must be used for ZUGFeRD invoices to a German invoice recipient.

- The presence of a specific PDF/A XMP extension scheme to describe the document as a ZUGFeRD invoice corresponding to this specification, as well as the corresponding XMP metadata.

Beyond that, there are no ZUGFeRD requirements for naming the PDF file itself.

2.1. PDF/A-3 conformant structure

A document conformant to PDF/A-3 must meet the requirements of the ISO 19005-3 [IS19005-3] standard. It describes the basic differences and restrictions of an A-3 file based on the underlying ISO 32000-1 standard. Essentially, these are guidelines that were already outlined in the previous standards PDF/A-1 and PDF/A-2.

The most important features of a PDF/A file, compared to any PDF document, are:

- It must have an identifier in the form of a PDF/A XMP extension scheme that explicitly contains the PDF/A property and the level of conformity.
- All metadata, even if not relevant to ZUGFeRD, must be embedded in XMP form. The previously common use of the Document Information Dictionary is no longer permitted. For such metadata, the XMP scheme can either be taken from the set of predefined schemes. Alternatively, a separate scheme must be created which imperatively and always must be embedded together with the metadata.
- All used character sets must be embedded in the PDF/A document. Instead of complete character sets, only subsets of the effectively used glyphs can be embedded for optimization.
- Other third-party files may only be embedded using the described A-3 compliant mechanism. Such external files are considered in the ZUGFeRD context as invoice accompanying documents.
- There may no longer be any active elements in the PDF/A. Such elements are for instance JavaScript for actions or Flash for animations.
- No encryption or other authorization control (e.g. usage rights) may be contained in the document.

2.2. Embedding the XML-File

Invoice data in XML-format are embedded using a so-called *File Specification Dictionary*[1] .

A prerequisite is the specification of a valid MIME type for the document to be embedded. In the case of ZUGFeRD, the MIME type of the invoice data is always `text / xml`.

The stream dictionary of the embedded file should have a key called `Params`. `Params` refers to a dictionary with file metadata, which must have at least one entry ModDate, containing the last modification date of the embedded file. An empty dictionary is not permitted in ZUGFeRD.

The embedded document should also be included in the `Names` object tree, in order to enable conformant PDF tools to display the file together with additional information.

[1] Cf. [IS32001], Cap. 7.11.3

Principally, it is possible to embed several files in the PDF/A-3 document. This allows the inclusion of information documents in PDF/A-3 format alongside the invoice data document for purposes of an audit, for instance. In order to indicate at PDF level which of the embedded files is the invoice data document, the name of the invoice data document must be included in the corresponding XMP metadata attribute.

The XML-invoice file must always be embedded using the name `factur-x.xml`.

2.2.1. Relationship of Embedded Files

An embedded file in a PDF/A-3 can principally refer to the entire (PDF-)document (*Document Level*), or to a a specific page (*Page Level*). The *File Specification Dictionary* will be either placed in the *Document Directory* or in the *Page Directory*, depending on the kind of reference applied. The linking is made through an array called `AF` (*„Associated Files“*) which is entered in the respective dictionaries and which contains a reference to the *File Specification Dictionary*.

The ZUGFeRD default allows only one single invoice data document to be embedded per PDF/A-3 document. Consequently, the *“Document Level”* is the relationship type to be selected. This does not affect the embedding of other documents and files which do not contain any invoice data. (cf. Paragraph 5.4.2 “Attachments and Explanatory Documents for Invoices”).

2.2.2. Data Relationship

Besides the kind of referencing, ISO 19005-3 requires the specification of a data relationship, meaning an indication about how the embedded document relates to the PDF-part, i.e. its visualisation. This data relationship is expressed by the `AFRelationship` tag and may have one of the following values:

- `Data` – The embedded file contains data which is used for the visual representation in the PDF-part, i.e. for tables or a graph.
- `Source` – The embedded file contains the source data for the visual representation in the PDF part, which is derived therefrom; for example for a PDF file which was generated via an XSL-transformation from from an (embedded) XML source file, or indeed an MS WORD file from which the PDF file was created.
- `Alternative` – This data relationship should be employed where the embedded files are an alternative representation of the content of the PDF.
- `Supplement` – This data relationship is to be used where the embedded file does not serve as source neither alternative representation, but where the file contains additional information, i.e. to simplify machine processing.
- `Unspecified` – This tag is used where none of the above-mentioned data relationship applies, or where there is an unknown data relationship.

Note

Specifying the data relationship serves a purely informative purpose; it has no technical ramifications within the PDF file. Nevertheless, validators will still test the validity of the kind of relationship depending on the country context.

The following application notes apply to Germany:
For the profiles EXTENDED, EN 16931 (COMFORT) and BASIC, the value `Alternative` must be specified for billers and bill recipients who are subject to German tax law. This is intended to clarify that the tax-relevant content of both representations corresponds and that the XML file is just a different or alternative and independent form of representation that is more suitable for machine processing (so-called "content-related identical multiple pieces ").
For the profiles BASIC WL and MINIMUM the value `Data` must be specified. In these profiles, the XML representation is only a booking aid. The complete data is only included in the image representation.

Conformance Level	Factur-X 1.0	ZUGFeRD 1.0	ZUGFeRD 2.0/2.1 outside Germany	ZUGFeRD 2.0/2.1 To a German recipient (2)
MINIMUM	Data	-	Data	Data
BASIC WL	Data	-	Data	Data
BASIC	Alternative or Source (1)	Alternative	Alternative or Source (1)	Alternative
EN 16931	Alternative or Source (1)	Alternative	Alternative or Source (1)	Alternative
EXTENDED	Alternative or Source (1)	Alternative	Alternative or Source (1)	Alternative

(1) Use ***Source*** where the PDF-representation results from the transformation of XML-data. Where this is not the case, use ***Alternative*****.**

If the visual representation was created from the structured XML file taking into account its complete content, the value `source` should be used in France. This indicates that the source file is the fully structured XML file and that the visual presentation was created from the structured XML file that is embedded in the PDF ("factur-x.xml").

The following figure illustrates this structure using the example of a ZUGFeRD-based XML calculation. The embedded invoice file (always with ZF21) has the name `factur-x.xml`. The element / AF is part of the *Document Dictionary* (directly under root), which is why the invoice file refers to the entire document. The data relationship is `Alternative`, i.e. the XML invoice data is an alternative form of displaying the PDF visualization.

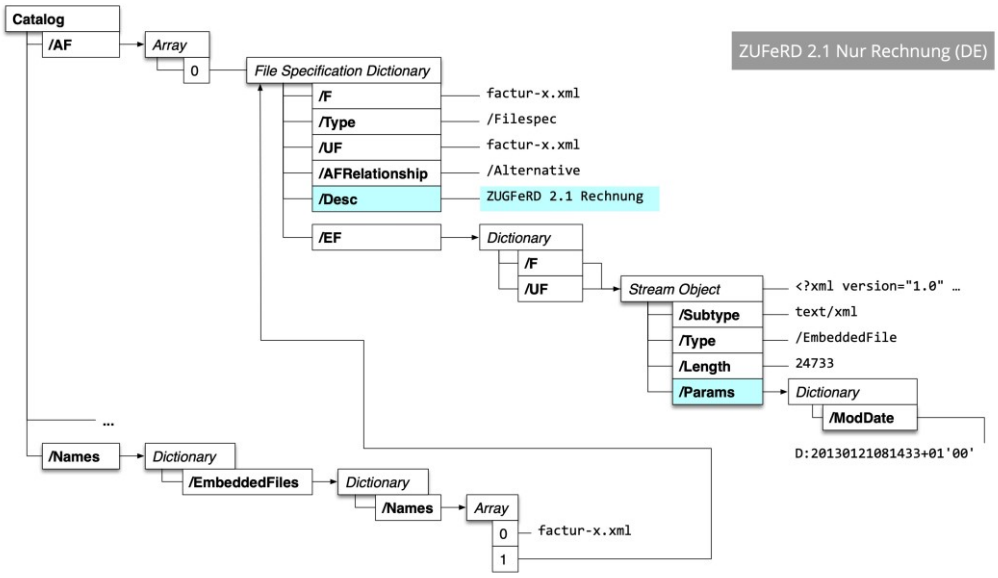

Fig. 1: Structure within the PDF-file

Note

- The graphic only shows the flat mapping as / Names Array. The alternative mapping as *"name tree node dictionary"* is also possible, in analogy to the hierarchical page tree (/ `Pages`).
- The color-coded elements are not mandatory but are recommended for better readability. This applies to the entries `/Desc` for the description and `/Params` for file parameters of the integrated invoice file.
- If `/Params` is used, then the entry `/ModDate` must be specified. This requirement results from the PDF / A-3 standard.

2.3. The PDF/A Extension Schema ZUGFeRD

The PDF/A standard requires metadata to define its own metadata schema in the case of user-specific metadata attributes (i.e. they are not included in the XMP schemes declared in the PDF / A standard).

This schema definition must be in line with the convention for the PDF/A extension schema[2].

[2] Cf. [TN0008], [TN0009]

Apart from embedding the concrete expression of the metadata, it is also necessary to embed the extension schema in every PDF/A document. It is not sufficient to just include a reference to an external repository.
An appropriate extension schema has been defined for the use of ZUGFeRD invoicing documents.

Below is a list of the extension schema's properties:

Property	Value	Description
Name of the extension schema	ZUGFeRD PDFA Extension Schema	
URI	`urn:factur-x:pdfa:CrossIndustryDocument:invoice:1p0#`	The „#"-character at the end is essential!
Schema prefix	`fx`	Prefix of the namespace

Table 1: Exemplary metadata (here the data of the sample invoice)

The following table shows the fields of the extension schema:

Field	Description	Example
`fx:DocumentType`	In ZUGFeRD invoices, the document type will always contain INVOICE	`INVOICE`
`fx:DocumentFileName`	The file name of the embedded invoicing data document; must be identical with the value of the /F entry in the File Specification Dictionary. In ZUGFeRD 2.1, this value is fixed as `factur-x.xml`	`factur-x.xml`
`fx:Version`	The major and minor version of the underlying invoice data specification. Here it is Factur-X 1.0, which is synonymous with ZUGFeRD 2.1. Note: revision numbers are not taken into account.	`1.0`
`fx:ConformanceLevel`	The profile of XML-invoicing data in accordance with the specifications by Factur-X (permitted values: MINIMUM, BASIC WL, BASIC, EN 16931, EXTENDED)[3]	`EN 16931`

Table 2: Fields of the XMP-extension schema

[3] Please note that there is an empty space in code „BASIC WL" between „BASIC" and „WL"; there is also an empty space in code „EN 16931 between „EN" and „16931".

Below is the complete PDF / A extension scheme for ZUGFeRD 2.1/Factur-X 1.0, which must always be embedded in the XMP metadata:

```
<rdf:Description xmlns:pdfaExtension="http://www.aiim.org/pdfa/ns/extension/"
                        xmlns:pdfaField="http://www.aiim.org/pdfa/ns/field#"
                        xmlns:pdfaProperty="http://www.aiim.org/pdfa/ns/property#"
                        xmlns:pdfaSchema="http://www.aiim.org/pdfa/ns/schema#"
                        xmlns:pdfaType="http://www.aiim.org/pdfa/ns/type#"
                        rdf:about="">
         <pdfaExtension:schemas>
            <rdf:Bag>
               <rdf:li rdf:parseType="Resource">
                  <pdfaSchema:schema>Factur-x PDFA Extension Schema</pdfaSchema:schema>
                  <pdfaSchema:namespaceURI>
                       urn:factur-x:pdfa:CrossIndustryDocument:invoice:1p0#
                    </pdfaSchema:namespaceURI>
                  <pdfaSchema:prefix>fx</pdfaSchema:prefix>
                  <pdfaSchema:property>
                     <rdf:Seq>
                        <rdf:li rdf:parseType="Resource">
                           <pdfaProperty:name>DocumentFileName</pdfaProperty:name>
                           <pdfaProperty:valueType>Text</pdfaProperty:valueType>
                           <pdfaProperty:category>external</pdfaProperty:category>
                           <pdfaProperty:description>
                               Name of the embedded XML invoice file
                             </pdfaProperty:description>
                        </rdf:li>
                        <rdf:li rdf:parseType="Resource">
                           <pdfaProperty:name>DocumentType</pdfaProperty:name>
                           <pdfaProperty:valueType>Text</pdfaProperty:valueType>
                           <pdfaProperty:category>external</pdfaProperty:category>
                           <pdfaProperty:description>INVOICE</pdfaProperty:description>
                        </rdf:li>
                        <rdf:li rdf:parseType="Resource">
                           <pdfaProperty:name>Version</pdfaProperty:name>
                           <pdfaProperty:valueType>Text</pdfaProperty:valueType>
                           <pdfaProperty:category>external</pdfaProperty:category>
                           <pdfaProperty:description>
                              The actual version of the ZUGFeRD data
                               </pdfaProperty:description>
                        </rdf:li>
                        <rdf:li rdf:parseType="Resource">
                           <pdfaProperty:name>ConformanceLevel</pdfaProperty:name>
                           <pdfaProperty:valueType>Text</pdfaProperty:valueType>
                           <pdfaProperty:category>external</pdfaProperty:category>
                           <pdfaProperty:description>
                                The conformance level of the ZUGFeRD data
                              </pdfaProperty:description>
                        </rdf:li>
                     </rdf:Seq>
                  </pdfaSchema:property>
               </rdf:li>
            </rdf:Bag>
         </pdfaExtension:schemas>
      </rdf:Description>
```

Note:

- Conformance Level „EN 16931“ is specified for the profile EN 16931 (COMFORT).
- The content of the field `fx:ConformanceLevel` has to be picked from the content of the element „`GuidelineSpecifiedDocumentContextParameter`“ (specification identifier BT-24) of the XML instance file.
- The space in the name “EN 16931” is intended and corresponds with the official standard. Alternatively, the spelling “EN16931” is permitted in implementations.
- The content in field `fx:Version` contains the version of the schema which has been used to generate the XML instance. A description about how to extrapolate this from specification identification BT-24 is being described in chapter 5.3.3.
- The URN of the extension schema must be terminated with a #-sign.

Example:

An exemplary allocation (here with data of the sample invoice) illustrates its use within a PDF/A document:

```
<rdf:Description rdf:about=""
     xmlns:fx="urn:factur-x:pdfa:CrossIndustryDocument:invoice:1p0#">
  <fx:DocumentType>INVOICE</fx:DocumentType>
  <fx:DocumentFileName>factur-x.xml</fx:DocumentFileName>
  <fx:Version>1.0</fx:Version>
  <fx:ConformanceLevel>EN 16931</fx:ConformanceLevel>
</rdf:Description>
```

Example 1: Applying the XMP extension schema

2.4. Transfer

2.4.1. Method of Transfer

ZUGFeRD stipulates by default the exchange via hybrid format. However, a definition of a specific method of transfer is not determined in the context of this specification. When deciding about the applicable method of transfer, we recommend taking into consideration the sensitivity of the invoice data and to match this by selecting the appropriate level of data protection required for the transfer between sender and recipient.

Consequently, an email is just as acceptable as DE-Mail, OpenPeppol networks, AS2 connections, HTTP/S Uploads or FTP transfers etc. If no special requirements are to be observed, it is permissible to make use of an email or an encrypted email process. The use of simple email can be combined with a White-list application to prevent unwanted spam.

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2.4.2. Attachments and Explanatory Documents for Invoices

The data model according to EN 16931 provides two ways to transfer explanatory documents for invoices:

1. The direct embedding of binary objects in the XML file. In such a case, the recipient must have appropriate software tools which would allow him access to data embedded in such a way. Hence, sender and recipient should enter into a bilateral agreement, e.g. a recommendation for use.

2. The reference in the shape of a URL, pointing to a repository which contains the enclosures substantiating the invoice. This repository must, of course, be attainable by the recipient of the invoice.

The second option is the one favoured by ZUGFeRD. Documents substantiating the invoice are being embedded directly the PDF/A-3 document. The relative URL path is contained in the XML data set.

Note:
ZUGFeRD profiles can also be used for technical purposes to exchange purely structured data. In such a case of transferring pure XML, it is essential to enter into a bilateral agreement about the method of transfer. It is advisable, too, to embed enclosures substantiating the invoice directly in the XML data set (variant 1).

2.4.2.1. Embedding into the PDF/A-3 Document

On the basis of the above-mentioned reason we recommend embedding such documents in the PDF file when applying a hybrid invoice. This would make the use of an additional tools unnecessary, whilst retaining the availability of the documents in accordance with the EU-norm. This is going to be described below.

Apart from embedding the XML invoicing file, the PDF/A-3 standard also allows the embedding of any number of other files. All it requires is to define the appropriate MIME-type for the file in question. In the context of ZUGFeRD it is therefore possible to also include spreadsheet files with calculations and measurements (XLSX, ODS,…), CAD-designs (PDF, DWG,…), images (JPEG, PNG…) or other XML-files with a technical reference to the invoice or which may be relevant for verification for accuracy of the invoice.

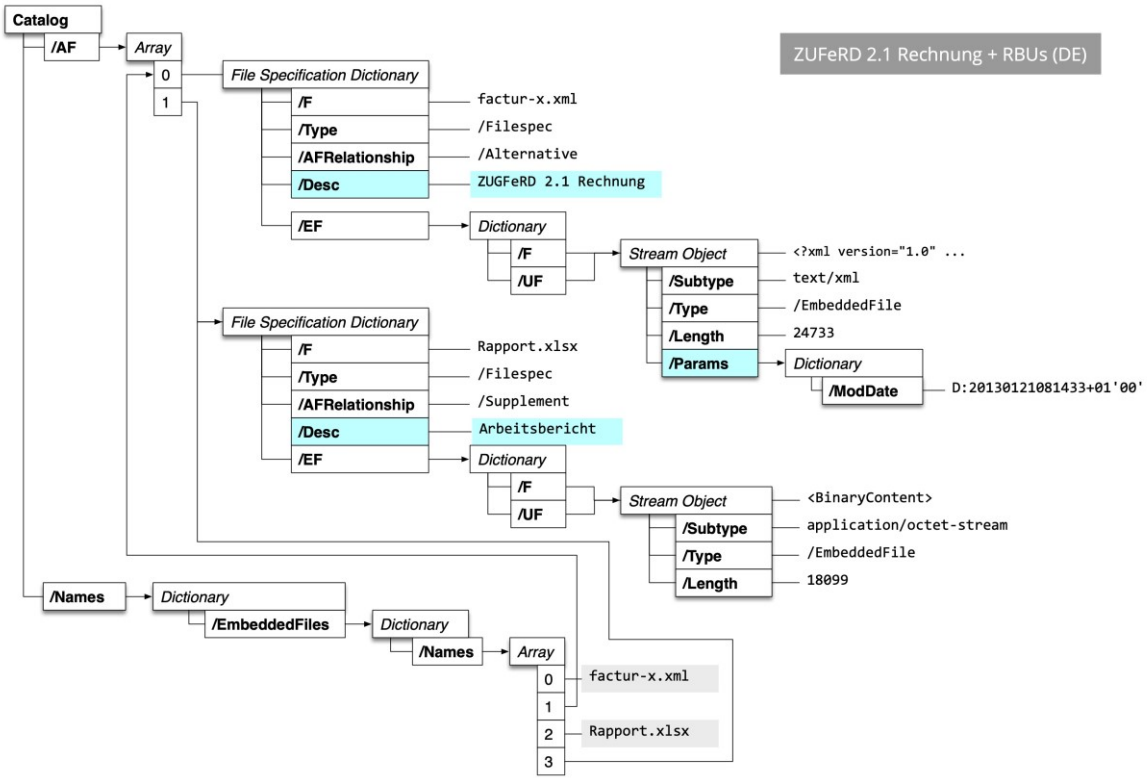

Figure 2: Structure within a PDF file – with documents substantiating the invoice

Whilst the data representation (XML instance) within a PDF/A-3 document is embedded following the standards of the ISO, no additional metadata need to be acquired or stored for additionally embedded files, according to ZUGFeRD. ZUGFeRD does not specify any structures of XMP metadata; if required, existing XMP-schemata from ISO-16684[4] may be used.

[4] Cf. [IS16684-1]

2.4.2.2. Formats

ZUGFeRD supports principally all file formats with valid MIME-type. However, EN 16931[5] limits the acceptable formats to the following types:

Format	MIME-Typ
PDF	`application/pdf`
PNG	`image/png`
JPEG	`image/jpeg`
Text, CSV	`text/csv`
Microsoft Excel	`application/vnd.openxmlformatsofficedocument.spreadsheetml.sheet`
OpenOffice Calc	`application/vnd.oasis.opendocument.spreadsheet`

Note:

In profiles EN 16931, BASIC, BASIC WL and MINIMUM, only the above-mentioned formats are to be used. Profile EXTENDED allows any format of a valid MIME type.

2.4.2.3. Path Specifications for Enclosures Substantiating the Invoice in XML

In order to integrate invoice-accompanying documents into the PDF/A-3 document, conformant with EN 16931, an XML element for every document must be added to the XML representation of the invoice:

`AdditionalReferencedDocument`

Complete Path:
`/ram:CrossIndustryInvoice/ram:SupplyChainTradeTransaction/ram:ApplicableHeaderTradeAgreement/ram:AdditionalReferencedDocument`

It must include the note that the URIID must contain a relative URL with the name of the invoice substantiating document. The URL is built according to RFC 3986 and RFC 8118. In this ZUGFeRD specification, the RFC 8118 is being applied correspondingly and substantiated. The relative URL consists exclusively of a PDF fragment identifier (`#ef=<`*`Document Name`*`>`).

Example:

In the following example, the ZUGFeRD-XML-files point towards an invoice substantiating document called “`rapport.png` (which, in this case, is a scanned work report in PNG-format). The fragment identifier `#ef` makes it clear that the referenced file „`rapport.png`“

[5] Cf. [EN16931-1]

has been embedded in the PDF/A-3, where it can either be viewed via a PDF-viewer or from where it can be extracted.
The `ram:TypeCode` with the value 916 defines that the referenced document relates to the invoice. The `ram:IssuerAssignedID` on the other hand may contain a number managed by the sender, or the ID of the document.

```
<ram:AdditionalReferencedDocument>
 <ram:IssuerAssignedID>42389</ram:IssuerAssignedID>
 <ram:URIID>#ef=rapport.png</ram:URIID>
 <ram:TypeCode>916</ram:TypeCode>
</ram:AdditionalReferencedDocument>
```

Example 2: Referencing a document that has been embedded in the PDF/A-part of the invoice-XML

2.5. Archiving

The demands about the archiving of electronic invoices can differ greatly in other countries. Since there are no common rules on archiving at the present time, the respective national regulations must be observed.

3. Appendix

3.1. Literature

[IS32001] ISO 32000-1, Document management — Portable document format — Part 1: PDF 1.7, www.iso.ch

[IS19001] ISO 19005-1: Document management — Electronic document file format for long-term preservation — Part 1: Use of PDF 1.4 (PDF/A-1), www.iso.ch

[IS19002] ISO 19005-2: Document management — Electronic document file format for long-term preservation — Part 2: Use of ISO 32000-1 (PDF/A-2), www.iso.ch

[IS19003] ISO 19005-3: Document management — Electronic document file format for long-term preservation - Part 3: Use of ISO 32000-1 with support for embedded files (PDF/A-3), www.iso.ch

[T0008] TechNote 0008: Predefined XMP Properties in PDF/A-1, PDF/A Competence Center, www.pdfa.org/doku.php?id=pdfa:en:techdoc

[T0009] TechNote 0009: XMP Extension Schemas in PDF/A-1, PDF/A Competence Center, www.pdfa.org/doku.php?id=pdfa:en:techdoc

[IS16684-1] ISO 16684-1:2012 - Graphic technology - Extensible Metadata Technology (XMP) specification, Part 1: Data model, serialization and core properties. , www.iso.ch

[EN 16931-1] Electronic invoicing – Part 1: Semantic data model of the core elements of an electronic invoice

[BMF2019] The Federal Ministry of Finance in Germany published new "*Basic Guidelines for the Maintaining and Keeping of Books[…]* (GoBD", 28. November 2019, Link

3.2. List of Graphics

3.3. List of Tables

3.4. List of Examples

3.5. List of Abbreviations

AWV	Arbeitsgemeinschaft für Wirtschaft und Verwaltung e.V.
B2A	Business to Administration, Von der Wirtschaft zur öffentlichen Verwaltung
B2B	Business to Business, Zwischen zwei Wirtschaftsorganisationen
B2C	Business to Consumer, Von der Wirtschaft zum Endverbraucher
BG	Business Group
BT	Business Term
CEN	Commité Européen de Normalisation
CII	Cross Industry Invoice
CIUS	Core Invoice Usage Specification, Anwendungsspezifikation einer Kernrechnung, die compliant zur EN 16931-1 ist
DIN	Deutsches Institut für Normung e.V.
EN	Europäische Norm
FeRD	Forum elektronische Rechnung Deutschland
FNFE-MPE	Forum Nationale de la Facture Electronique et des Marchés Publices Electroniques
ISO	International Organization for Standardization
KoSIT	Koordinierungsstelle für IT Standards
TR	Technical Report
TS	Technical Specification
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business
UStAE	Umsatzsteuer-Anwendungs-Erlass
UStG	Umsatzsteuergesetz
XML	Extended Markup Language