UN/CEFACT

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Centre for Trade Facilitation and Electronic Business

(UN/CEFACT)

METHODOLOGY AND TECHNOLOGY PROGRAMME DEVELOPMENT AREA

SPECIFICATIONS DOMAIN

JSON SCHEMA NAMING AND DESIGN RULES TECHNICAL SPECIFICATION

SOURCE: API TechSpec Project Team

ACTION: For public review

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Abstract

This JSON Schema Naming and Design Rules technical specification defines an architecture and a set of rules necessary to define, describe and use JSON to consistently express business information exchanges namely via APIs. It is based on the JSON Schema team's specification and the UN/CEFACT Core Components Technical Specification. This specification will be used by UN/CEFACT to define JSON Schema and JSON Schema documents which will be published as UN/CEFACT standards. It will also be used by other organisations who are interested in maximizing inter- and intra-industry interoperability.

1.1 Document History

Phase	*Status*	*Date Last Modified*
Draft development	First draft	17 Dec 2021
Draft development	Draft	30 Mar 2022

Table 1 – Document history

1.2 Change Log

The change log is designed to alert users about significant changes that occurred during the development of this document.

Date of Change	Version	Paragraph Changed	Summary of Changes
24 Jan 2022	0.2	3	Adding rules for basic data types
25 Jan 2022	0.3	3	
08 Feb 2022	0.4	3.6	Extensions, Restrictions, ABIEs, QDTs
17 Feb 2022	0.5	5	Adding rules list into appendix B
22 Feb 2022	0.5	3.2, 3.4, 3.5	JSON schema versioning Date Time qDT Identification Schemes part of qDT Note on quantity unit of Rec20+21 JSON schema structure
14 Mar 2022	0.6	3.3 R 13 3.5.4 3.5.5 3.6.1 3.6.3 New R36, higher rules renumbered 3.7 R 37	Handling of hard spaces Adjusted to modifications in next chapter Modified code and identifier list export Added example for lower layer restriction New chapter about contextualisation Deprecated ABIEs
21 Mar 2022	0.7	R9 R28 3.6.3	Handling of $id Placement of code list files Explanation of Export methods
30 Mar 2022	0.8	R 12ff. Table 8 R 39	Adding new R 12 to R 14 for the origin of JSON schema names. Adjusted export options New R 39 for UN/CEFACT publication

Table 2 - Document change log

1.3 JSON Schema Naming and Design Rules Project Team

We would like to recognize the following for their significant participation in the development of this Unites Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) JSON Schema Naming and Design Rules technical specification.

ATG2 Chair

Marek Laskowski

Project Lead

Jörg Walther

Lead editors

Andreas Pelekies Gerhard Heemskerk

1.4 Acknowledgements

This version of UN/CEFACT JSON Schema Naming and Design Rules Technical Specification has been created to foster convergence among Standards Development Organizations (SDOs). It has been developed in close coordination with these organizations:

- TBD

1.5 Contact information

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1.6 Notation

The keywords MUST, MUST NOT, REQUIRED, SHALL, SHALL NOT, SHOULD, SHOULD NOT, RECOMMENDED, MAY, and OPTIONAL, when they appear in this specification, are to be interpreted as described in Internet Engineering Task Force (IETF) Request For Comments (RFC) 2119[1].

Example A representation of a definition or a rule. Examples are informative.

[Note] Explanatory information. Notes are informative.

[1] Key words for use in RFCs to Indicate Requirement Levels - Internet Engineering Task Force, Request For Comments 2119, March 1997, http://www.ietf.org/rfc/rfc2119.txt?number=2119

[R n|c]	Identification of a rule that requires conformance. Rules are normative. In order to ensure continuity across versions of the specification, rule numbers "n" are randomly generated. The number of a rule that is deleted will not be re-issued. Rules that are added will be assigned a previously unused random number. The second number "c" after the pipe symbol | identifies the conformance category of the given rule as defined in section 2.6 Conformance.
`Courier`	All words appearing in **`bolded courier font`** are values, objects or keywords. Representation of non-printable characters like white-space are surrounded by double-quotes, e.g. `" "`.
`<<var>>`	All placeholders are surrounded by double less-than and greater-than characters. The meaning of the placeholder is described in the text.

1.7 Audience

The audience for this UN/CEFACT JSON Schema Naming and Design Rules Technical Specification is:

- Members of the UN/CEFACT Applied Technologies Groups who are responsible for development and maintenance of UN/CEFACT JSON Schema.
- The wider membership of the other UN/CEFACT Groups who participate in the process of creating and maintaining UN/CEFACT JSON Schema definitions.
- Designers of tools who need to specify the conversion of user input into JSON Schema definitions adhering to the rules defined in this document.
- Designers of JSON Schema definitions outside of the UN/CEFACT Forum community. These include designers from other organizations that have found these rules suitable for their own organizations.

2 Introduction

2.1 Objectives

This JSON Schema NDR technical specification document forms part of a suite of documents that aim to support modern web developers to make use of UN/CEFACT semantics.

It can be applied on any layer of the UN/CEFACT Reference Data Models to create conformant JSON artefacts in accordance with the UN/CEFACT Core Components Technical Specification Version 2.01. This includes comprehensive RDMs like Buy-Ship-Pay, or Accounting as well as their contextualization like the Supply-Chain-Reference-Data-Model (SCRDM), Multi-Modal-Transport-Reference-Data-Model (MMTRDM) down to single message implementation like the Road Consignment Note (eCMR) or the certificate of origin (COO).

2.2 Requirements

Users of this specification should have an understanding of basic data modelling concepts, basic business information exchange concepts and basic JSON concepts.

2.3 Dependencies

This document depends on

- UN/CEFACT Core Components Technical Specification Version 2.01.
- API TechSpec Open API design rules.

2.4 Caveats and Assumptions

Schemas created as a result of employing this specification should be made publicly available as schema documents in a universally free and accessible and searchable library. UN/CEFACT will make its contents freely available to any government, individual or organization who wishes access.

Although this specification defines schema components as expressions of Reference Data Models, non-CCTS developers can also use it for other logical data models and information exchanges.

This specification does not address transformations via scripts or any other means. It does not address any other representation of CCTS artefacts – such as XML, JSON-LD, OWL, and XMI.

2.5 Guiding Principles

- JSON Schema Creation
  UN/CEFACT JSON Schema design rules will support JSON Schema creation through handcrafting as well as automatic generation.
- Tool Use and Support
  The design of UN/CEFACT JSON Schema will not make any assumptions about sophisticated tools for creation, management, storage, or presentation being available.
- Technical Specifications
  UN/CEFACT JSON Schema Naming and Design Rules will be based on technical specifications holding the equivalent of JSON Schema recommendation status.
- JSON Schema Specification
  UN/CEFACT JSON Schema Naming and Design Rules will be fully conformant with the JSON Schema recommendation.
- Interoperability
  The number of ways to express the same information in a UN/CEFACT JSON Schema and UN/CEFACT JSON instance document is to be kept as close to one as possible.
- Maintenance
  The design of UN/CEFACT JSON Schema must facilitate maintenance.
- Context Sensitivity
  The design of UN/CEFACT JSON Schema must ensure that context-sensitive document types are not precluded.
- Ease of implementation
  UN/CEFACT JSON Schema should be intuitive and reasonably clear in the context for which they are designed. They should allow an intuitive implementation in REST APIs, a.k.a. RESTful API, as well as other interchange appliances.

2.6 Conformance

Designers of JSON Schema in governments, private sector, and other standards organizations external to the UN/CEFACT community have found this specification suitable for adoption. To maximize reuse and interoperability across this wide user community, the rules in this specification have been categorized to allow these other organizations to create conformant JSON Schema while allowing for discretion or extensibility in areas that have minimal impact on overall interoperability.

Accordingly, applications will be considered to be in full conformance with this technical specification if they comply with the content of normative sections, rules and definitions.

[R 1|1]
Conformance SHALL be determined through adherence to the content of the normative sections and rules. Furthermore, each rule is categorized to indicate the intended audience for the rule by the following:

Category	Description
1	Rules which must not be violated. Else conformance and interoperability are lost.
2	Rules which may be modified while still conformant to the NDR structure.

Table 3 - Conformance categories

3 JSON Schema Architecture

3.1 Basic architecture

The CCTS defines naming and design rules for a hierarchical data model that supports a document centric modelling approach as well as a resource based modelling approach. In order to support the document centric modelling approach and to be backwards compatible it is designed in a hierarchy. REST APIs on the other hand are resource based only. This means that when moving from CCTS to REST APIs using JSON Schema both options are to be considered. In addition the JSON syntax has got its own naming and design rules that differs from the naming and design rules from the CCTS. This section elaborates on how to move from CCTS to JSON Schema.

3.1.1 JSON serialization in a RESTful context

In order to use the JSON schema artefacts in REST API specifications, the question arises at which level a hierarchical structure is split into a resource-based structure. The UN/CEFACT project API Town Plan has already dealt with this fundamental problem. It formulated that the decision cannot be made centrally in advance. Rather, it depends on the concrete implementation needs in the respective concrete project or the concrete domain.

For this reason, a form of serialization is chosen within the JSON Schema NDR that allows both options for each decision point: The retention of the document-centric hierarchy and the separation according to resources. All ASBIE[2] connections are affected by this. The corresponding data type is modelled in the chapter ASBIE Serialization.

3.1.2 Overall JSON Schema Structure

[R 2|1]
In the scope of this specification, a JSON schema is a file that complies to a JSON schema definition as defined at https://json-schema.org. It may include subschemas defined in the **`$defs`** section. A JSON schema fragment means both the overall JSON schema as well as each of its included subschemas.

[R 3|1]
Each JSON schema SHALL be declared to be a "JSON Draft 2020-12 schema[3]" with the appropriate **`$schema`** string property defined as **`https://json-schema.org/draft/2020-12/schema`**.

[2] Associated Business Information Entity

[3] https://json-schema.org/specification-links.html

[R 4|1]
Each JSON schema SHALL contain a "**`title`**" annotation. It SHALL be an overall description title.

[R 5|1]
Each JSON schema SHALL contain a "**`description`**" annotation. It contains an overall description for that file as well as copyright information.

[R 6|1]
Each declared Document and Library ABIE definitions and their BBIE[4] and ASBIE members SHALL contain a "**`title`**" annotation and a "**`description`**" annotation. The "**`title`**" annotation SHALL be the CCTS Dictionary Entry name for the BIE. "**`description`**" annotation shall be the CCTS definition value. Members of enums SHALL NOT contain the "**`title`**" or the "**`description`**" annotation.

[R 7|1]
The "**`unevaluatedProperties`**" property of each JSON schema fragment SHALL be set to **`false`**, excluding subschemas for primitive data types, unqualified data types and qualified data types. For subschemas specifying primitive data types, unqualified data types or qualified data types the "**`unevaluatedProperties`**" property SHALL be stated as defined in this document.

3.2 Versioning and "$id"

Fostering interoperable and highly automated data exchange means enabling machines to process the information in the correct syntactical structure and the correct semantic meaning. As requirements change on a regular base, the created standards need to adapt to the new requirements. Therefore, it is necessary to define the given version of the technical artefacts in a machine-readable way.

It is a clear goal to keep the JSON schema artefact structure as compatible as possible with older and future versions.

[R 8|1]
The JSON schema file names SHALL NOT contain a version information. Differences in versions are only indicated by $id and the folder structure in which the JSON schema artefacts are located.

[R 9|1]
Each JSON schema being published by user groups or standardisation organisations SHALL contain an identifier for the schema in the appropriate **`$id`** URI property. JSON

[4] Basic Business Information Entity

schema exports that are only used in a closed environment (e.g. for testing) do NOT NEED to contain the **$id** property.
The URI SHALL follow the following format:
"$id": "<basepath>/<version>/<BIE>"
with **<basepath>** identifying the originator. For UNECE artefacts that is "https://service.unece.org/trade/uncefact/json-schema"
<version> in the UNECE publication format e.g. "D22A"
<BIE> with one
- distinct name for each message assembly ABIE[5] (e.g. Cross Industry Invoice) without a file extension
- name for all BBIE components: "BasicComponents"
- distinct name for every RDM set of Library ABIE components: e.g. "BSPRDMComponents" or "SCRDMComponents"
- distinct name for each extension collection

The JSON schema file name SHALL be build with the following format:
<originator>-<abbreviation>.json
with
- **<originator>** identifying the originator. For UNECE artefacts it SHALL be **UNECE**.
- **<abbreviation>** identifying the RDM set of Library ABIE components

```
[Example]
"$id":      "https://service.unece.org/trade/uncefact/json-schema/D22A/
            BasicComponents"
UNECE-BasicComponents.json
```

[R 10|1]
The BasicComponents JSON schema file SHALL contain all subschemas for primitive data types, unqualified data types as well as qualified data types.

3.3 General naming rules moving from CCTS to JSON

The dictionary entry names follow specific naming rules defined in the CCTS containing special characters like full stops `.` and white spaces `" "` that are not allowed in JSON for naming entities.

The basic rules listed below apply when transferring CCTS names in JSON schema.

[R 11|1]
A property is a name/value pair inside a JSON object. The property name is the key or name part of the property. The property value is the value part of the property.

```
[Example]
{
      "propertyName": "propertyValue"
}
```

[5] Aggregated Business Information Entity

[R 12|1]
JSON property names SHALL be derived from Dictionary Entry Names (DEN). In e.g. in a BBIE or ASBIE the DEN contains the DEN of the surrounding ABIE, it SHALL be removed. In case a BBIE or ASBIE contains consecutive identical words the duplication SHALL be removed. If by applying the NDR rules words in the DEN are duplicated, the duplication SHALL be removed.

[R 13|1]

Any special characters such full stops `.`, non-breaking spaces (ASCII code 160) and underscores `_` SHALL be removed from the underlying Dictionary Entry Name. If a digit (0-9) was before and another digit after the white space, the white space SHALL be replaced by a hyphen `-`.
[Example]
`"This. is_ a. class. name"` is represented as `"thisIsAClassName"`
`"ISO 4217 3 A"` is represented as `"ISO4217-3A"`

[R 14|1]

JSON property names SHALL be lower camel-cased ASCII strings and JSON schema compliant: The character after a white space shall be a capital letter. Capital letters in the DEN SHALL NOT be kept.
`[Example]`
`"Specified. IBAN. Identifier"` is represented as `"specifiedIbanId"`
`"AAA Archive_ Document. Specified. AAA Archive_ Archive Parameter"` is represented as `"specifiedAaaArchiveParameter"`

[R 15|1]
The abbreviations and acronyms SHALL be used as defined in Table 4. [R 14|1] SHALL be taken into account.

CCTS Appearance	JSON Representation

`"Uniform Resource. Identifier"`
or
`"URI_ Identification. Identifier"`
	`"Uri"`
	with
	`"type": "string"`
	`"format": "uri"`
	The rule for abbreviating `"Identifier"` is not applied in this case. It SHALL NOT be abbreviated as `"UrId"`.

`"Identification Scheme"`	`"Scheme"`
`"Details"`	`"Type"`
`"Identifier"`	`"Id"`
`"Indicator"`	SHALL be omitted. `"isOrHas"` is added as a prefix.
`"Identification. Identifier"`	`"Id"`
`"Text"`	SHALL be omitted

Table 4 – JSON Representation for abbreviations and acronyms

[R 16|1]
The Object Class Term **"Identification Scheme"** SHALL be represented as **"Scheme"**. [R 14|1] SHALL be taken into account.

3.4 JSON schema landscape

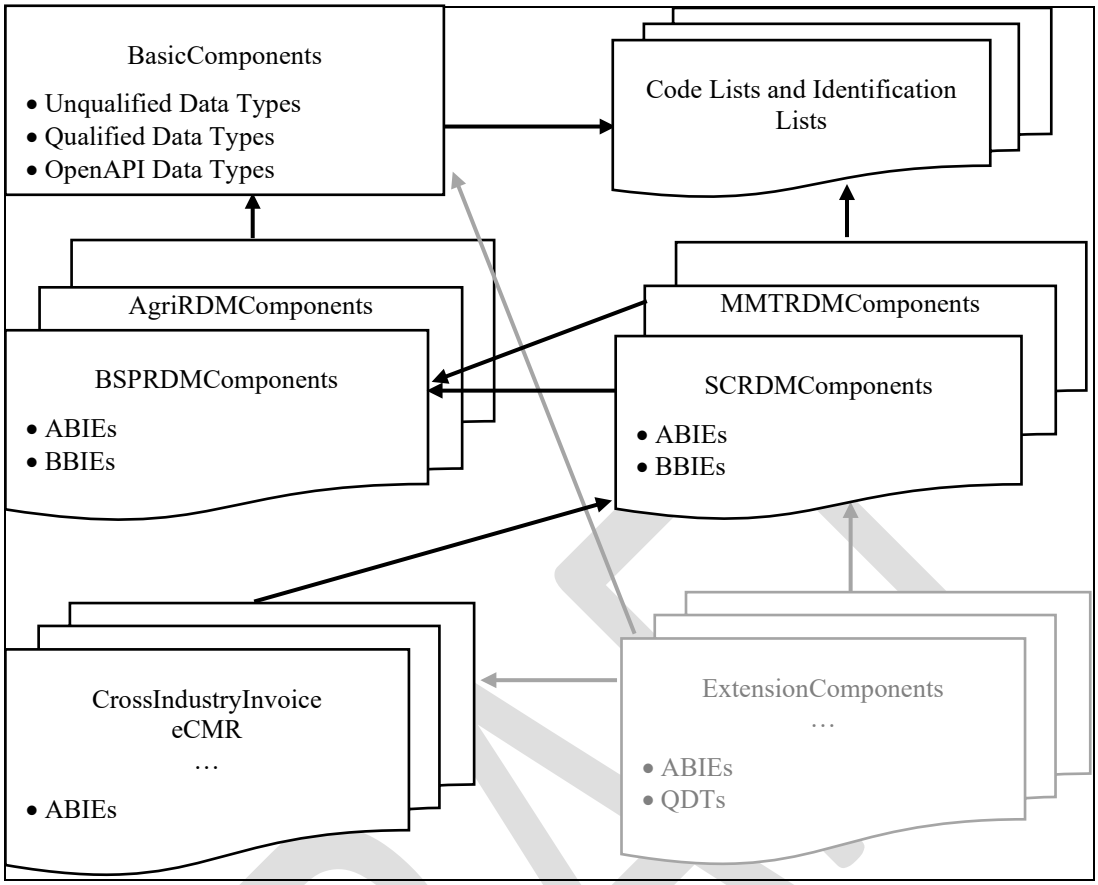

Figure 1 – JSON schema structure

3.5 Data types

The CCTS defines a hierarchical relationship of basic data types. From primitive data types (PDT), Approved Core Component Types (CCT) and finally unqualified data types (UDT) are formed.[6]

3.5.1 Primitive Data Types

The decimal data type, which is used in particular to represent amounts (in a specific currency), as well as measured values, requires special treatment. JSON does not support such a decimal data type. It only supports the data type "number", which is technically implemented as a float or double precision data type. There are many discussions[7], but also practical experiences (e.g. based on the application of validation rules from the implementation of EN16931), which show the difficulties of using float data types instead of a decimal data type. In summary, it can be stated that the use of a float data type inevitably leads to rounding differences and imprecise representations of the transmitted values. Since the implementation of the UNECE reference data models involves the exchange of business data, precise transmission of values is the top priority. With this in mind, the decimal data type is represented as a string representation in JSON schema. This can be implemented cleanly and without loss in the various implementation languages, even if direct arithmetic use is not possible at JSON level.

Examples for the implementation of the decimal type are:

Language	Implementation
C#	decimal
Go	decimal
Java	java.math.BigDecimal
JavaScript	decimal.js
Python	decimal.Decimal

Table 5 – Implementation of the decimal type in different languages

[R 17|1]
Primitive data types (PDT) SHALL be represented in JSON schema, as stated in Table 6. They SHALL be placed under **`$defs/pdt/`**.

[6] See CCTS Section 8.1

[7] See e.g. https://github.com/zalando/jackson-datatype-money/blob/main/MONEY.md

CCTS Primitive data type	JSON Representation
Binary	`"binaryType": { "title": "Binary", "description": "", "type": "string", "format": "byte" }`
Boolean	`"type": "boolean"`
Decimal	`"decimalType": { "title": "Decimal", "description": "", "type": "string", "pattern": "^([+-]?(0?|[1-9][0-9]*)(\\.?\\d+))$" }`
Integer	`"type": "integer"`
String	`"type": "string"`

Table 6 – JSON representation of CCTS Primitive data types

3.5.2 Approved Core Component Types

The Approved Core Component Types have no direct representation in JSON schema. Instead, UDTs are mapped directly into JSON schema.

3.5.3 Unqualified Data Types

UDTs form the basis for all further data structures of the CCTS. They consist of the actual value (**`content`**), as well as usually optional supplementary components[8]. During contextualisation, some of these supplementary components are often omitted. This in fact multiplies the number of UDTs in the actual implementation and complicates it technically. For this reason, contextualisation of UDTs is not mapped into JSON schema. Instead, the complete UDTs in the higher data types are always used.

[R 18|1]
Unqualified data types SHALL be represented in subschemas. **`"Type"`** as part of the Dictionary Entry Name SHALL be retained.

[R 19|1]
The CCTS content property SHALL be represented in a subschema with the name **`"content"`**. Its data type SHALL use the underlying PDT. The content-property SHALL be required.

[8] See CCTS section 8.1

[R 20|1]
Property names of supplementary components SHALL NOT repeat the JSON subschemas property name.

[R 21|1]
Supplementary components may reference to code lists and/or identification schemes. In this case the JSON property SHALL reference the appropriate code list or identification scheme as defined in section 3.5.5 Other Qualified Data Types.

[R 22|1]
Unqualified data types SHALL be represented in subschemas as shown in Table 7. The **`title`** and **`description`** properties are not shown in the following table. Instead they are indicated with the placeholder **`<title and description>`** as those can change over time. They SHALL be published in alignment with rules [R 4|1], [R 5|1], and [R 6|1]. They SHALL be placed under **`$defs/udt`**.

CCTS Unqualified data type	**JSON Representation**
• Amount. Type • Amount. Content • Amount Currency. Identifier • Amount Currency. Code List Version. Identifier	**`"amountType": {`** **`  <<title and description>>`** **`  "type": "object",`** **`  "properties": {`** **`  "content": {`** **`  <<title and description>>`** **`  "$ref": "#/$defs/pdt/decimalType"`** **`  },`** **`  "currencyId": {`** **`  <<title and description>>`** **`  "$ref": "ISO_4217-3A.json#/$defs/codeList/iso4217-3AType"`** **`  },`** **`  "currencyCodeListVersionId": {`** **`  <<title and description>>`** **`  "type": "string"`** **`  }`** **`  },`** **`  "required": [ "content" ],`** **`  "unevaluatedProperties": false`** **`}`**

• Binary Object. Type
• Binary Object. Content
• Binary Object. Format. Text
• Binary Object. Mime. Code
• Binary Object. Encoding. Code
• Binary Object. Character Set. Code
	`"binaryObjectType": {`
	`  <<title and description>>`
	`  "type": "object",`
	`  "properties": {`
	`  "content": {`
	`  <<title and description>>`
	`  "$ref": "#/$defs/pdt/binaryType"`
	`  },`
	`  "format": {`
	`  <<title and description>>`
	`  "type": "string"`
	`  },`
	`  "mimeCode": {`

• Binary Object. Uniform Resource. Identifier
• Binary Object. Filename. Text
	<<title and description>>
	"type": "string"
	},
	"encodingCode": {
	<<title and description>>
	"$ref": "UNECE_CharacterSetEncoding.json#/$defs/codeList/characterSetEncodingType"
	},
	"characterSetCode": {
	<<title and description>>
	"$ref": "UNECE_CharacterSets.json#/$defs/codeList/characterSetsType"
	},
	"uri": {
	<<title and description>>
	"type": "string",
	"format": "uri"
	},
	"filename": {
	<<title and description>>
	"type": "string"
	}
	},
	"required": ["content"] ,
	"unevaluatedProperties": false
	}

• Code. Type
• Code. Content
• Code List. Identifier
• Code List. Agency. Identifier
• Code List. Agency Name. Text
• Code List. Name. Text
• Code List. Version. Identifier
• Code. Name. Text
• Language. Identifier
• Code List. Uniform Resource. Identifier Code List Scheme. Uniform Resource. Identifier
	"codeType": {
	<<title and description>>
	"type": "object",
	"properties": {
	"content": {
	<<title and description>>
	"type": "string"
	},
	"listId": {
	<<title and description>>
	"type": "string"
	},
	"listAgencyId": {
	<<title and description>>
	"$ref": "UNECE_UNTDID-3055.json#/$defs/codeList/untdid3055Type"
	},
	"listAgencyName": {
	<<title and description>>
	"type": "string"
	},
	"listName": {
	<<title and description>>
	"type": "string"
	},
	"listVersionId": {
	<<title and description>>
	"type": "string"
	},
	"name": {
	<<title and description>>
	"type": "string"

	}, "languageId": { <<title and description>> "$ref": "UNECE_UNTDID-3453.json#/$defs/codeList/untdid3453Type" }, "listUri": { <<title and description>> "type": "string", "format": "uri" }, "listSchemaUri": { <<title and description>> "type": "string", "format": "uri" } }, "required": ["content"] , "unevaluatedProperties": false }
• Date Time. Type	"dateTimeType": { <<title and description>> "type": "string", "format": "date-time" }
• Date. Type	"graphicType": { <<title and description>> "$ref": "#/$defs/udt/binaryObjectType" }
• Graphic. Type	"graphicType": { <<title and description>> "$ref": "#/$defs/udt/binaryObjectType" }
• Identifier. Type • Identifier. Content • Identification Scheme. Identifier • Identification Scheme. Name. Text • Identification Scheme Agency. Identifier • Identification Scheme. Agency Name. Text • Identification Scheme. Version. Identifier • Identification Scheme Data. Uniform Resource. Identifier • Identification Scheme. Uniform Resource. Identifier	"identifierType": { <<title and description>> "type": "object", "properties": { "content": { <<title and description>> "type": "string" }, "schemeId": { <<title and description>> "type": "string" }, "schemeName": { <<title and description>> "type": "string" }, "schemeAgencyId": { <<title and description>> "$ref": "UNECE_UNTDID-3055.json#/$defs/codeList/untdid3055Type" }, "schemeAgencyName": { <<title and description>>

	"type": "string"
	},
	"schemeVersionId": {
	<<title and description>>
	"type": "string"
	},
	"schemeDataUri": {
	<<title and description>>
	"type": "string",
	"format": "uri"
	},
	"schemeUri": {
	<<title and description>>
	"type": "string",
	"format": "uri"
	}
	},
	"required": ["content"],
	"unevaluatedProperties": false
	}

• Indicator. Type	"indicatorType": {
	<<title and description>>
	"type": "boolean"
	}

• Measure. Type
• Measure. Content
• Measure Unit. Code
• Measure Unit. Code List Version. Identifier
	"measureType": {
	<<title and description>>
	"type": "object",
	"properties": {
	"content": {
	<<title and description>>
	"$ref": "#/$defs/pdt/decimalType"
	},
	"unitCode": {
	<<title and description>>
	"$ref": "UNECE_UNTDID-6411.json#/$defs/codeList/untdid6411Type"
	},
	"unitCodeListVersionId": {
	<<title and description>>
	"type": "string"
	}
	},
	"required": ["content"],
	"unevaluatedProperties": false
	}

• Name. Type
• Text. Content
• Language. Identifier
• Language. Locale. Identifier
	"nameType": {
	<<title and description>>
	"$ref": "#/$defs/udt/textType"
	}

• Numeric. Type
• Numeric. Content
• Numeric. Format. Text
	"numericType": {
	<<title and description>>
	"type": "object",
	"properties": {

	"content": {
	<<title and description>>
	"$ref": "#/$defs/pdt/decimalType"
	},
	"format": {
	<<title and description>>
	"type": "string"
	}
	},
	"required": ["content"] ,
	"unevaluatedProperties": false
	}

• Percent. Type	"percentType": {
	<<title and description>>
	"$ref": "#/$defs/udt/numericType"
	}

• Picture. Type	"pictureType": {
	<<title and description>>
	"$ref": "#/$defs/udt/binaryObjectType"
	}

• Quantity. Type
• Quantity. Content
• Quantity Unit. Code
• Quantity Unit. Code List. Identifier
• Quantity Unit. Code List Agency. Identifier
• Quantity Unit. Code List Agency Name. Text
	"quantityType": {
	<<title and description>>
	"type": "object",
	"properties": {
	"content": {
	<<title and description>>
	"$ref": "#/$defs/pdt/decimalType"
	},
	"unitCode": {
	<<title and description>>
	"$ref": "UNECE_REC-20+21.json#/$defs/codeList/rec20+21Type"
	},
	"unitCodeListId": {
	<<title and description>>
	"type": "string"
	},
	"unitCodeListAgencyId": {
	<<title and description>>
	"$ref": "UNECE_UNTDID-3055.json#/$defs/codeList/untdid3055Type"
	},
	"unitCodeListAgencyName": {
	<<title and description>>
	"type": "string"
	}
	},
	"required": ["content"],
	"unevaluatedProperties": false
	}

	[Note] Rec 20 supports a combination with Rec 21 by adding a prefix to the Rec 21 code values. In the usage of this JSON subschema, the combined code list can be restricted as needed.

• Rate. Type	"rateType": {
	<<title and description>>
	"$ref": "#/$defs/udt/numericType"
	}

• Sound. Type	"soundType": {
	<<title and description>>
	"$ref": "#/$defs/udt/binaryObjectType"
	}

• Text. Type
• Text. Content
• Language. Identifier
• Language. Locale. Identifier
	"textType": {
	<<title and description>>
	"type": "object",
	"properties": {
	"content": {
	<<title and description>>
	"type": "string"
	},
	"languageId": {
	<<title and description>>
	"$ref": "ISO_6391-1-2A.json#/$defs/codeList/iso6391-1-2AType"
	},
	"languageLocaleId": {
	<<title and description>>
	"type": "string"
	}
	},
	"required": ["content"],
	"unevaluatedProperties": false
	}

• Time. Type	"timeType": {
	<<title and description>>
	"type": "string",
	"format": "time"
	}

• Value. Type	"valueType": {
	<<title and description>>
	"$ref": "#/$defs/udt/numericType"
	}

• Video. Type	"videoType": {
	<<title and description>>
	"$ref": "#/$defs/udt/binaryObjectType"
	}

Table 7 – JSON representation of Unqualified data types

3.5.4 Qualified Data Types for Date and Time

The CCTS supports the wide subset of the different date and time formats of ISO 8601. However, this flexibility is only needed and used to a limited extent in practical applications. Often, date, time and combined information can be reduced to their simple representation form, which is directly supported by JSON schema. There exist a few

exceptions, so that in the CCTS some specialised QDTs have been defined. The modelling of these QDTs goes back to the early EDIFACT definitions and no longer seems up-to-date for application in OpenAPI using JSON schema. Nevertheless, this notation is still used in a wide community. Against this background, the following simplification of these QDTs is used:

[R 23|1]

The **"Date Mandatory_ Date Time. Type"** SHALL be replaced by the **formattedDateTimeType**.

[R 24|1]

The **"Time Only_ Formatted_ Date Time. Type"** SHALL be replaced by the **formattedDateTimeType**.

The implementation of the Formatted Date Time Type shall take into account the direct mappability of certain date and time information directly into JSON schema. To allow an intuitive implementation, the code list UNTDID 2379 is replaced by a JSON specific variant for this purpose.

[R 25|1]

The **"Formatted_ Date Time. Type"** SHALL be represented as follows.

```
"formattedDateTimeType": {
  <<title and description>>
  "oneOf": [
        { "type": "string", "format": "date-time" },
        { "type": "string", "format": "time" },
        { "type": "string", "format": "date" },
        { "type": "string", "format": "duration" },
        { "type": "object",
          "properties": {
            "content": { "type": "string" },
            "format": { "$ref": "UNECE_UNTDID2379-
JSON.json#/$defs/codeList/untdid2379JsonType" }
          },
          "required": ["content", "format"]
        }
      ]
}
```

[Example]

JSON schema definition:

```
{  "properties": {
    "myDateTime": { "$ref": "#/$defs/formattedDateTimeType"}
   }
}
```

JSON instance:

Hint: The presence of "content" indicates that it is a UNECE specific format not directly supported by JSON schema.

```
{
  "myDateTime": {"content": "2022-W02", "format": "CCYY-Www"},
  "myDateTime": {"content": "1T10:00/1T12:00", "format":
"NThh:mm/NThh:mm"},
```

```
  "myDateTime": "2022-02-11",
  "myDateTime": "2022-02-11T12:23:58Z",
  "myDateTime": "12:23:58Z",
  "myDateTime": "P10W"
}
```

[R 26|1]

Based on the code list **"UNTDID 2379"** an additional code list **"UNTDID 2379 json"** SHALL be specified. All format definitions that are already represented in their meaning by existing JSON date and time formats SHALL be omitted. This code list SHALL be maintained in accordance with UNTDID 2379. All other formats SHALL be represented as follows.

```
"untdid2379JsonType": {
  "title": "Date and Time format codes for JSON representation.",
  "description": "This code list is based on UNTDID 2379. It is adjusted
to take JSON date and time representation into account.\n
# The following abbreviations are used\n
* 'C' - Century\n
* 'Y' - Year\n
* 'M' - Month\n
* 'D' - Day\n
* 'h' - Hour\n
* 'm' - Minute\n
* 's' - Second\n
* 'w' - Week\n
* 'T' - Time zone offset separator (+/-/Z) \n
\n
* 'A' - 10 day period within a month of a year\n
* 'B' - 1: First half month; 2: second half month\n
* 'E' - Week of a month\n
* 'G' - Working days\n
* 'H' - Half month\n
* 'I' - 1-9: Shift in a day\n
* 'K' - 1-5: First to fifth week in a month\n
* 'M' - Trimester: A period of three months\n
* 'N' - 1-7: Numeric representation of the day (Monday = 1, Sunday = 7)\n
* 'P' - A period of 4 months\n
* 'Q' - Quarter\n
* 'RR' - 00-99: Time period\n
* 'S' - Semester\n
*\n
* Hyphens and additional character in a format string are kept. According
to ISO 8601 a slash is used to separate time spans.\n
# Codes from UNTDID 2379 and their representation in JSON\n
* '2' - is represented as 'date' format\n
* '3' - is represented as 'date' format\n
* '4' - is represented as 'date' format\n
* '5' - is represented as 'date-time' format\n
* '6' - is represented as 'CCYY-MM-B'\n
* '7' - is represented as 'CCYY-MM-K'\n
* '8' - is represented as 'CCYY-MM-DD-I'\n
* '9' - is represented as 'CCYY-MM-DD-RR'\n
* '10' - is represented as 'date-time' format\n
* '101' - is represented as 'date' format\n
* '102' - is represented as 'date' format\n
* '103' - is represented as 'YY-Www-N'; 01 is first week of January; 1 is
always Monday\n
* '104' - is represented as 'MM-WEE/MM-WEE'\n
```

```
* '105' - is represented as 'YY-DDD'; January the first = Day 001; Always
start numbering the days of the year from January 1st through December
31st \n
* '106' - is represented as '-MM-DD'\n
* '107' - is represented as 'DDD'\n
* '108' - is represented as 'WW'\n
* '109' - is represented as '-MM-'\n
* '110' - is represented as '--DD'\n
* '201' - is represented as 'date-time' format\n
* '202' - is represented as 'date-time' format\n
* '203' - is represented as 'date-time' format\n
* '204' - is represented as 'date-time' format\n
* '205' - is represented as 'date-time' format\n
* '206' - is represented as 'date-time' format\n
* '207' - is represented as 'date-time' format\n
* '208' - is represented as 'date-time' format\n
* '209' - is represented as 'date-time' format\n
* '210' - is represented as 'hh:mm:ssZhh:mm/hh:mm:ssZhh:mm'\n
* '301' - is represented as 'date-time' format\n
* '302' - is represented as 'date-time' format\n
* '303' - is represented as 'date-time' format\n
* '304' - is represented as 'date-time' format\n
* '305' - is represented as '-MM-DDThh:mm' format\n
* '306' - is represented as '--DDThh:mm' format\n
* '307' - is represented as 'date-time' format\n
* '308' - is represented as 'CCYY-MM-DDThh:mmZhh:mm/CCYY-MM-
DDThh:mmZhh:mm' \n
* '401' - is represented as 'time' format\n
* '402' - is represented as 'time' format\n
* '404' - is represented as 'time' format\n
* '405' - is represented as 'duration' format\n
* '406' - is represented as 'Zhh:mm'\n
* '501' - is represented as 'hh:mm/hh:mm' \n
* '502' - is represented as 'hh:mm:ss/hh:mm:ss' \n
* '503' - is represented as 'hh:mm:ssZhh:mm/hh:mm:ssZhh:mm' \n
* '600' - is represented as 'CC'\n
* '601' - is represented as 'YY' \n
* '602' - is represented as 'CCYY' \n
* '603' - is represented as 'YY-S' \n
* '604' - is represented as 'CCYY-S' \n
* '608' - is represented as 'CCYY-Q' \n
* '609' - is represented as 'YY-MM' \n
* '610' - is represented as 'CCYY-MM' \n
* '613' - is represented as 'YY-MM-A' \n
* '614' - is represented as 'YY-MM-A' \n
* '615' - is represented as 'YY-Www \n
* '616' - is represented as 'CCYY-Www' \n
* '701' - is represented as 'YY/YY' \n
* '702' - is represented as 'CCYY/CCYY' \n
* '703' - is represented as 'YY-S/YY-S' \n
* '704' - is represented as 'CCYY-S/CCYY-S' \n
* '705' - is represented as 'YY-P/YY-P' \n
* '706' - is represented as 'CCYY-P/CCYY-P' \n
* '707' - is represented as 'YY-Q/YY-Q' \n
* '708' - is represented as 'CCYY-Q/CCYY-Q' \n
* '709' - is represented as 'YY-MM/YY-MM' \n
* '710' - is represented as 'CCYY-MM/CCYY-MM' \n
* '713' - is represented as 'YY-MM-DDThh:mm/YY-MM-DDThh:mm' \n
* '715' - is represented as 'YY-Www/YY-Www' \n
* '716' - is represented as 'CCYY-Www/CCYY-Www' \n
* '717' - is represented as 'YY-MM-DD/YY-MM-DD' \n
```

```
* '718' - is represented as 'CCYY-MM-DD/CCYY-MM-DD' \n
* '719' - is represented as 'CCYY-MM-DDThh:mm/CCYY-MM-DDThh:mm' \n
* '720' - is represented as 'NThh:mm/NThh:mm' \n
* '801' - is represented as 'duration' format \n
* '802' - is represented as 'duration' format \n
* '803' - is represented as 'duration' format \n
* '804' - is represented as 'duration' format \n
* '805' - is represented as 'duration' format \n
* '806' - is represented as 'duration' format \n
* '807' - is represented as 'duration' format \n
* '808' - is represented as 'S' \n
* '809' - is represented as 'P' \n
* '810' - is represented as 'M' \n
* '811' - is represented as 'H' \n
* '812' - is represented as 'A' \n
* '813' - is represented as 'N' \n
* '814' - is represented as 'G' \n
",
  "oneOf": [
   { "const": "CCYY-MM-B" },
   { "const": "CCYY-MM-K" },
   { "const": "CCYY-MM-DD-I" },
   { "const": "CCYY-MM-DD-RR" },
   { "const": "YY-Www-N" },
   { "const": "MMWEE/MMWEE" },
   { "const": "YY-DDD" },
   { "const": "-MM-DD" },
   { "const": "DDD" },
   { "const": "-WW" },
   { "const": "-MM-" },
   { "const": "--DD" },
   { "const": "hh:mm:ssZhh:mm/hh:mm:ssZhh:mm" },
   { "const": "-MM-DDThh:mm" },
   { "const": "--DDThh:mm" },
   { "const": "CCYY-MM-DDThh:mmZhh:mm/CCYY-MM-DDThh:mmZhh:mm" },
   { "const": "Zhh:mm" },
   { "const": "hh:mm/hhmm" },
   { "const": "hh:mm:ss/hh:mm:ss" },
   { "const": "hh:mm:ssZhh:mm/hh:mm:ssZhh:mm" },
   { "const": "CC" },
   { "const": "YY" },
   { "const": "CCYY" },
   { "const": "CCYY-S" },
   { "const": "CCYY-Q" },
   { "const": "YY-MM" },
   { "const": "CCYY-MM" },
   { "const": "YY-MM-A" },
   { "const": "CCYY-MM-A" },
   { "const": "YY-Www" },
   { "const": "CCYY-Www" },
   { "const": "YY/YY" },
   { "const": "CCYY/CCYY" },
   { "const": "YY-S/YY-S" },
   { "const": "CCYY-S/CCYY-S" },
   { "const": "YY-P/YY-P" },
   { "const": "CCYY-P/CCYY-P" },
   { "const": "YY-Q/YY-Q" },
   { "const": "CCYY-Q/CCYY-Q" },
   { "const": "YY-MM/YY-MM" },
   { "const": "CCYY-MM/CCYY-MM" },
   { "const": "YY-MM-DDThh:mm/YY-MM-DDThh:mm" },
```

```
    { "const": "YYWww/YYWww" },
    { "const": "CCYYWww/CCYYWww" },
    { "const": "YY-MM-DD/YY-MM-DD" },
    { "const": "CCYY-MM-DD/CCYY-MM-DD" },
    { "const": "CCYY-MM-DDThh:mm/CCYY-MM-DDThh:mm" },
    { "const": "NThh:mm/NThh:mm" },
    { "const": "S" },
    { "const": "P" },
    { "const": "M" },
    { "const": "H" },
    { "const": "A" },
    { "const": "N" },
    { "const": "G" }
  ]
}
```

3.5.5 Other Qualified Data Types

In the CCTS code and identifier lists are specified as qualified data types (QDT). They base on the UDT **codeType or idType** The UDT codeType and as before described idType offers the ability to state code list or identification scheme specific properties like the publishing agency or the used code list version or schema version.

Not in every code list and identification scheme or qualified data type all of these properties are applicable, which is taken into account.

[R 27|1]
Each QDT that does not fall under section 3.5.4 SHALL be restricted according to its definition applying the method described in section 3.6.1.

[Example]

```
"unitMeasureType": {
  "title": "Unit_ Measure. Type",
  "description": "A numeric value determined by measuring an object along
with the specified unit of measure.",
  "$ref" : "#/$defs/udt/measureType",
  "required": ["unitCode"],
  "properties": {
    "unitCodeListVersionId": false
   }
}
```

[R 28|1]
Each QDT SHALL be represented in a subschema. If code or id values are specified locally, they SHALL be as a **oneOf** combination of **const** definitions. They SHALL NOT be specified as **enum** arrays. Each code value SHALL be represented as a **string** type. If the values of codes and ids are organised in code and identification schemes the corresponding JSON schema SHALL refer to the appropriate code list or identification scheme.

[R 29|1]
Each code list and identification scheme SHALL be specified in a separate JSON schema file.

A JSON schema file SHALL be created for each code list and identification scheme being used. Its name SHALL represent the name of the code list or identification scheme and SHALL be unique with the following form:

<Code List Agency Name>_<Code List Name or Identifier>.json

<Identification Scheme Agency Name>_<Identification Scheme Name or Identifier>.json

Where:

- All special characters SHALL be removed from the name. A period **.** in the version number is replaced by the letter **p**.
- <Code List Agency Name> – Agency that maintains the code list.
- <Identification Scheme Agency Name> – Agency that maintains the identification scheme.
- <Code List Name or Identifier> – If a code list identifier exists in the UNTDID, the identifier is given in the format **UNTDID<identifier>**. Else the code list name is stated as assigned by the publishing agency.
- <Identification Scheme Name or Identifier> – If an identification scheme identifier exists in the UNTDID, the identifier is given in the format **UNTDID<identifier>**. Else the identification scheme name is stated as assigned by the publishing agency.

The file SHALL be placed in a subfolder **codelists** of the export path. The **$id** property SHALL reflect this subfolder structure.

```
[Example]
UNECE_UNTDID-1001.json
OpenPEPPOL_DocumentTypes.json
```

[R 30|2]

It is a clear goal to keep the JSON schema artefacts as compatible with code lists and identification schemes as possible. For this reason the code list version and identification scheme version is neither part of the .json filename nor part of the type name. But it is part of the $id, so that JSON schema files can be used for differentiating versions if needed. If for some reason more than one version of a code list or identification scheme needs to be used in a specific scenario, the **<Code List Version>** or **<Identification Scheme Version>** SHOULD be added to the file name in the following format:

<Code List Agency Name>_<Code List Name or Identifier>_<Code List Version>.json

<Identification Scheme Agency Name>_<Identification Scheme Name or Identifier>_<Identification Scheme Version>.json

Since the invention of JSON, there has been repeated discussion about whether JSON should support comments in schema files. In terms of its basic concept, JSON is data-only and it was deliberately decided not to support comments. Nevertheless, as versioning progressed, annotations such as description and also $comment were introduced. The latter is supposed to be ignored by parsers and should not be used to present information to

schema users. Instead $comment is only intended to contain information for future schema developers e.g. to highlight schema maintenance information[9]. A much discussed topic for years is the commenting of enums.

JSON Schema does not support comments in the .JSON file analogous to the double slash in languages like C or the hashtag as in PHP. Some JSON editors support such comments proprietarily. However, usually only one of the two variants, which often correspond to the conventions of one's own programming language. Since there is consequently no universal convention, the UNECE JSON Schema code and identifier lists dispense with such proprietary comments.

This NDR technical specification is created with the goal of applicability of the JSON schema artefacts for use in OpenAPI specifications. This means that for the implementer of such a specification, the documentation of the individual code or identifier values is important.

Starting with OpenAPI 3.1 the preferred representation of code lists is a **`oneOf`** combination of **`const`** definitions. This allows code names and definitions to be added directly to the definition of each individual code. In addition, further amendments like adding validity periods for individual code values become possible.

[R 31|1]
The **`description`** property of the JSON schema specifying a code or identifier list SHALL list the copyright notice information as defined in the CCL. This includes the code or identifier list name, code or identifier list agency, code or identifier list version, and copyright information.

[R 32|2]
The **`title`** property of the subschema specifying the **`const`** definitions holding the values of a code or identifier list SHOULD be the code name value in English language. The **`description`** property of the subschema specifying the **`const`** definitions holding the values of a code or identifier list SHOULD be the code definition value in English language.

The following rule defines the representation of code and identifier lists as files.

[R 33|1]
Code lists SHALL be represented in a subschema of the corresponding schema file with the following naming convention: **`$defs/codeList/<Code List Name or Identifier>Type`**

[9] See https://json-schema.org/understanding-json-schema/reference/generic.html#comments

with <Code List Name or Identifier> – If a code list identifier exists in the UNTDID, the identifier is given in the format untdid<identifier>. Else the code list name is stated as assigned by the publishing agency with special characters removed.

The following example shows a complete code list JSON schema file content.

```
[Example]
{
  "$schema": "https://json-schema.org/draft/2019-09/schema",
  "$id": "https://service.unece.org/trade/uncefact/json-
schema/D22A/UNECE_UNTDID-3131",
  "title": "Address type code",
  "description": "<<copyright notice information>>",
  "$defs": {
    "codeList": {
      "untdid3131Type": {
        "title": "Address type code",
        "oneOf": [
         {
          "const": "1",
          "title": "Postal Address"
         },
         {
          "const": "2",
          "title": "Fiscal Address"
         },
         {
          "const": "3",
          "title": "Physical Address"
         },
         {
          "const": "4",
          "title": "Business Address"
         },
         {
          "const": "5",
          "title": "Delivery To Address"
         },
         {
          "const": "6",
          "title": "Residential Address"
         },
         {
          "const": "7",
          "title": "Mail To Address"
         },
         {
          "const": "8",
          "title": "Postbox Address"
         }
        ]
      }
    }
  }
}
```

[R 34|1]

Identification schemes SHALL be represented in a subschema of the corresponding schema file with the following naming convention:

$defs/identificationScheme/<Indentification Scheme Name or Identifier>Type

with < Identification Scheme Name or Identifier> – If an identification scheme identifier exists in the UNTDID, the identifier is given in the format untdid<identifier>. Else the code or identification scheme name is stated as assigned by the publishing agency with special characters removed.

The following example shows a complete identification scheme JSON schema file content.

```
[Example]
{
  "$schema": "https://json-schema.org/draft/2019-09/schema",
  "$id": "https://service.unece.org/trade/uncefact/json-
schema/D22A/ISO_639-1-2A",
  "title": "Language identifier",
  "description": "<<copyright notice information>>",
  "$defs": {
    "identificationScheme": {
      "iso639-1-2AType": {
        "title": "Language identifier",
        "oneOf": [
         {
          "const": "AR",
          "title": "ARABIC"
         },
         {
          "const": "AS",
          "title": "ASSAMESE"
         },
         {
          "const": "AV",
          "title": "AVARIC"
         },
         {
          "const": "AY",
          "title": "AYMARA"
         },
         {
          "const": "AZ",
          "title": "AZERBAIJANI"
         },
         {
          "const": "BA,
          "title": "BASHKIR"
         },
         {
          "const": "BE",
          "title": "BELARUSIAN"
         }
        ]
      }
    }
  }
}
```

3.6 Restriction and Extension

3.6.1 Restriction

The CCTS defines methods of restriction to create e.g. industry specific profiles of the CCL. One output of this process are the Reference Data Models (RDMs) being published like the Supply-Chain-Reference-Data Model (SCRDM) or the Multi-Modal-Transport-Reference-Data-Model (MMT RDM). For data transmission via messages, this method is also used to restrict cardinalities and values of code or identifier list. A significant part of the standardisation activity of UN/CEFACT has been dealing with this very issue for many years.

As defined in rule [R 9|1] for each individual layer of data models a separate JSON schema file is published.

[R 35|1]

Restrictions to CCTS objects SHALL be represented in a subschema as follows:

Cardinalities

- From 0..1 to 1..1

```
[Example]
"toBeRestrictedType": {
  "type": "object",
  "properties": {
    "id": { "type": "string" }
  }
},
"restrictingType": {
  "$ref": "#/$defs/toBeRestrictedType",
  "required": ["id"]
}
```

- From 0..1 to 0..0 (forbidden)

```
[Example]
"toBeRestrictedType": {
  "type": "object",
  "properties": {
    "id": { "type": "string" },
    "name": { "type": "string" }
  }
},
"restrictingType": {
  "$ref": "#/$defs/toBeRestrictedType",
  "properties": {
    "id": false
  }
}
```

- From 0..unbounded to 0..n with n < unbounded

```
[Example with n=2]
"toBeRestrictedType": {
  "type": "object",
  "properties": {
    "id": {
      "type": "array",
      "items": { "type": "string }
```

```
    }
  }
},
"restrictingType": {
  "$ref": "#/$defs/toBeRestrictedType",
  "properties": {
    "id": { "maxItems": 2 }
  }
}
```

- From 0..unbounded to n..unbounded

```
[Example with n=2]
"toBeRestrictedType": {
  "type": "object",
  "properties": {
    "id": {
      "type": "array",
      "items": { "type": "string }
    }
  }
},
"restrictingType": {
  "$ref": "#/$defs/toBeRestrictedType",
  "properties": {
    "id": { "minItems": 2 }
  }
}
```

Restriction of value ranges

```
[Example restricting content to values with exact 2 fraction digits]
"restrictingType": {
  "allOf": [
    { "$ref": "UNECE-BasicComponents.json#/$defs/udt/amountType" },
    { "properties": {
        "content": { "pattern": "^.*\..{2}$" }
      }
    }
  ]
}
```

Restriction of const

```
[Example restricting content to a code list subset]
"addressType": {
  "type": "object",
  "properties": {
    "countryId": { "$ref": "UNECE-
BasicComponents.json#/$defs/qdt/countryIdType"}
  }
},
"restrictingType": {
  "allOf": [
    { "$ref": " #/$defs/addressType" },
    { "properties": {
        "countryId": { "const": ["CH", "DE", "FR"] }
      }
    }
  ]
}
```

The same type of restriction can be applied if restrictions are defined on a lower level.

```
[Example]

{
 "$defs": {
  "restriction": {
   "allOf": [
    {
     "$ref": "#/$defs/levelOne"
    },
    {
     "properties": {
      "oneFirst": {
       "properties": {
        "twoFirst": false
       }
      }
     }
    }
   ]
  },
  "levelOne": {
   "type": "object",
   "properties": {
    "oneFirst": {
     "$ref": "#/$defs/levelTwo"
    },
    "oneSecond": {
     "type": "string"
    }
   }
  },
  "levelTwo": {
   "type": "object",
   "properties": {
    "twoFirst": {
     "type": "string"
    },
    "twoSecond": {
     "type": "string"
    }
   }
  }
 }
}
```

Figure 2: Example for second level restrictions

3.6.2 Extension

The CCTS does not support extensions. Therefore, no NDR rules analogous to the Restrictions chapter can be set up for the CCTS that extend cardinalities, value ranges or **`enum`**. Should an implementation nevertheless require such an extension, the result is no longer compliant with the artefacts according to this technical specification. Technically, this can be achieved by combining a schema with **`anyOf`**.

However, especially when implementing OpenAPI specifications, extensions to the properties are needed. For example, to add metadata to the API endpoints.

[R 36|1]

The BasicComponents SHALL define a JSON subschema for extension as follows:
`"$defs": {`
`  "extensibleType": {`
`  "patternProperties": { "^x-": true}`
`  }`
`}`

The **`extensibleType`** allows users to add their own JSON properties to the JSON subschemas. The only rule they have to follow is that they must start with **`x-`**. This makes it compliant to the extension method defined in the OpenAPI specification. An example can be found in the next section in rule [R 41|1].

3.6.3 Publication and reusing contextualization

The CCL is undergoing a continuous development. This way it contains definitions that are not used any more in newer versions. In order to prevent confusion with published data types that are not used any more the RDM level is the lowest export level for any UN/CEFACT publication.

[R 37|1]
The base of all JSON schema exports SHALL be the RDM level. This means that each underlying CCL basic data type SHALL be profiled and contextualised according to the RDM definition. Only data types that are used in an RDM SHALL be exported.

If the rules defined in this section are applied to the entire CCL, the resulting JSON artefacts can become complex and very large. This approach creates a high level of traceability of the restrictions and ensures a consistent (re-)use of the individual data types.

In a practical application of an API, however, these libraries can be unnecessarily large. Especially if only a subset of the CCL is used.

Therefore, it can be useful to export "snapshots" of the required (sub-) structures as JSON artefacts. The procedure here corresponds to the XML design principle "Venetian blind": Only one JSON schema file is created, which contains all the required data types for the use

case. All properties that are not required are not even exported. Restrictions are kept to a minimum. Compliance with the CCL is mandatory.

[R 38|2]
A user community may decide to create "snapshot" JSON schema artefacts for a specific subset of the CCL. A "snapshot" JSON schema artefact SHALL contain all relevant data types that are needed to define the subset. The "snapshot" JSON schema artefact MAY contain additional restrictions and extensions.

Together with the "snapshot" export there exist three possible ways of creating JSON schema artefacts:

Export variant	Description
Library export	The library export creates one JSON schema file for each level of contextualisation as they are defined by the UN/CEFACT standards. It creates one large CCL JSON schema representation as a foundation. On top of it it creates one JSON schema file contextualising and restricting the CCL to the defined RDMs and document-centric structures. **Pro** The complete CCL, all RDMs as well as all (document-centric) message structure definitions are exported as defined by UN/CEFACT standards. A maximum of re-usable data structures and definitions are created. It assures by design that any implementation is consistent and ready for any process-amendment. **Contra** Any implementation needs to handle the huge CCL library as a base import as well as the multi-layer-restrictions as they are defined by UN/CEFACT standards. For example the eCMR message is defined as a contextualisation of a master message structure for all document-centric messages defined by UN/CEFACT. The contained data structure is process specific contextualisation of a multi modal transport reference data model. The MMT-RDM is a transport specific contextualisation of the Buy-Ship-Pay reference data model. And this again is a contextualisation of the underlying CCL. Thus an implementation could get rather complex while at the same time achieving a maximum compliance level.
Subset export	The subset export follows the same principles as the library export with one major difference: Only the needed data structures of the selected subset are exported. All other data structures are omitted. This way the file size and content is reduced to a minimum set of information, while at the same time keeping all relations available. **Pro** In addition to the arguments defined in the library export the subset export is easier to handle in respect of file size and quantity of data objects. **Contra**

	The complexity of layers of contextualisation is still the same as with the library export. Amendments of the subset lead to changes in the underlying objects. Only those data objects are exported that are needed for a specific subset. When the scope of the subset is widened in a future version, it may need additional objects in the underlying data structures. This means that implementations of the subset need to be updated at all players at the same time.
Snapshot export	Content wise the snapshot export is equal to the subset export. The main difference is that the multi-layer-contextualisation over a set of several JSON schema files is removed. Only one single JSON schema file is created that contains all necessary data structures of the snapshot objects. It is comparable with the XML "Ventian Blind" approach. Underlying data objects are still defined (like a party data type). But they only contain schema objects being used in the snapshot selection. **Pro** The complexity for the given snapshot is reduced to a minimum. Only one single self-contained JSON schema file is created. The JSON schema file can easily be used by all common JSON tools as well as OpenAPI design tools. The exported data structures are compliant to the UN/CEFACT standards and reflect "the compilation" of all restrictions and contextualisation. **Contra** One self-contained JSON schema file is created for each individual snapshot. If this approach is used in a pre-defined environment it works quite well. Thus it is important to clearly define the snapshot content in advance. Things start to get complicated if in one implementation more than one self-contained JSON schema files are used. Let's assume that for example one self-contained JSON schema file is created for each document-centric message (as it is done with XML schema files). Each of those JSON schema files defined the underlying data types (e.g. party). In an OpenAPI specification, it is not so easy to combine those multiple schema files into one single OpenAPI file as it may come to conflicts between the underlying data types. The reason is that the same data type with the same name may have a diverging contextualisation between the different JSON schema files.

Table 8: Export variants

[R 39|1]
A UNECE publication SHALL provide a library export on a server being able to handle the necessary requirements for a global community accessing the published artefacts. In addition, UNECE SHOULD provide an additional snapshot export for each contextualised document ABIE.

[Note]

```
As the $id property of a JSON schema must represent a valid URL aspects
of scalability of the provided service have to be taken into account. One
option could be to provide the publication in a GIT-compliant repository.
```

3.7 ABIE and BBIE representation in JSON Schema

[R 40|1]

Each ABIE SHALL be represented in a JSON subschema. ABIEs that are marked as deprecated from a former version SHALL NOT be represented in a JSON subschema.

```
[Note]

For example an ABIE is defined to be deprecated starting in version D20B.
When the JSON schema artefacts for version D21A are exported, the ABIE
SHALL NOT be represented in this export.
```

[R 41|1]

All ABIE representations in JSON subschemas SHALL include a reference to the **`extensibleType`**.

```
[Example]
"abieType": {
    "title": "The Dictionary Entry Name",
    "description": "The description",
    "type": "object",
    "properties": {
      "p1": { "type": "string" }
    },
    "required": ["p1"],
    "$ref": "UNECE-BasicComponents.json#/$defs/extensibleType",
    "unevaluatedProperties": false
  }
}
[Example of a valid JSON object]
{
  "p1": "value",
  "x-addedStringProperty": "added value",
  "x-addedObjectProperty": { "content": "a123"}
}
[Example of an invalid JSON object]
{
  "p1": "value",
  "addedStringProperty": "added value"
}
```

[R 42|2]

Extension property names SHOULD follow the same naming conventions as defined in this technical specification.

3.7.1 ASBIE representation in JSON Schema supporting document based and resource-based information

The CCTS was invented for the purpose of standardising and modelling classic EDI messages. Even today, document-based data exchange is still predominant, especially in the B2B and B2A environment.

As described at the beginning of this technical specification, REST APIs are characterised by the fact that they are not based on the exchange of business documents, but on the management of resources. This means that, for example, business partner information can be managed separately from transaction data such as an invoice or a transport order. In CCTS, these are all the places where ABIEs are associated with each other in the form of ASBIEs.

With the aim of supporting REST APIs via the JSON schema artefacts, it is precisely at this point that the option of switching from document-centred to resource-centred data exchange must be supported.

Resource-based data management means that resources must have unique identifiers. Therefore, only those ABIEs can be converted to resources that have a unique identifier. Using this unique identifier represented as an URI, the information about a buyer in an order can be retrieved following the URI to the party information of the buyer.

[R 43|1]
The BasicComponents SHALL define a JSON subschema for resource based data exchange as follows:

```
"$defs": {
  "resourceType": {
    "type": "string",
    "format": "uri"
  }
}
```

[R 44|1]
All ASBIEs whose ABIEs contain an identifier SHALL be modelled using an **`oneOf`** choice between the **`resourceType`** and the associated ABIE. All other ASBIEs SHALL be referenced directly. In both cases, the defined cardinality SHALL be observed. To stay focused title, description etc. are not shown in the following example.

```
[Example]
"$defs": {
  "invoiceType": {
    "type": "object",
    "properties": {
      "buyer": {
        "oneOf": [
          { "$ref": "UNECE-BasicComponents.json#/$defs/resourceType" },
```

```
          { "$ref": "#/$defs/partyType" }
        ]
      }
    },
    "required": [ "buyer" ],
    "$ref": "UNECE-BasicComponents.json#/$defs/extensibleType",
    "unevaluatedProperties": false
  },
  "partyType": {
    "type": "object",
    "properties": {
      "id": {
        "type": "array",
        "items":  {
          "$ref": "UNECE-BasicComponents.json#/$defs/udt/identifierType"
        }
      },
      "name": { "type": "string" },
      "postalTradeAddress": { "$ref": "#/$defs/addressType" }
    },
    "$ref": "UNECE-BasicComponents.json#/$defs/extensibleType",
    "unevaluatedProperties": false
  },
  "addressType": {
    "type": "object",
    "properties": {
      "street": { "type": "string"},
      "city": { "type": "string"},
      "postalCode": { "type": "string"},
      "countryCode": { "$ref": "UNECE-
BasicComponents.json#/$defs/qdt/countryIdType"}
    },
    "$ref": "UNECE-BasicComponents.json#/$defs/extensibleType",
    "unevaluatedProperties": false
  }
}
```

4 Appendix A: Complete Example

This section provides an illustrative example of many of the constructs described in this guidance document.

4.1 Certificate of Origin Model

4.2 JSON Schema serialization

5 Appendix B: Naming and Design Rules List

Rule #	Rule
[R 1|1]	Conformance SHALL be determined through adherence to the content of the normative sections and rules. Furthermore, each rule is categorized to indicate the intended audience for the rule by the following: 1. Rules which must not be violated. Else conformance and interoperability is lost. 2. Rules which may be modified while still conformant to the NDR structure.
[R 2|1]	In the scope of this specification, a JSON schema is a file that complies to a JSON schema definition as defined at https://json-schema.org. It may include subschemas defined in the **`$defs`** section. A JSON schema fragment means both the overall JSON schema as well as each of its included subschemas.
[R 3|1]	Each JSON schema SHALL be declared to be a "JSON Draft 2020-12 schema " with the appropriate **`$schema`** string property defined as **`https://json-schema.org/draft/2020-12/schema.`**
[R 4|1]	Each JSON schema SHALL contain a "**`title`**" annotation. It SHALL be an overall description title.
[R 5|1]	Each JSON schema SHALL contain a "**`description`**" annotation. It contains an overall description for that file as well as copyright information.
[R 6|1]	Each declared Document and Library ABIE definitions and their BBIE and ASBIE members SHALL contain a "**`title`**" annotation and a "**`description`**" annotation. The "`title`" annotation SHALL be the CCTS Dictionary Entry name for the BIE. "**`description`**" annotation shall be the CCTS definition value. Members of enums SHALL NOT contain the "**`title`**" or the "**`description`**" annotation.
[R 7|1]	The "**`unevaluatedProperties`**" property of each JSON schema fragment SHALL be set to false, excluding subschemas for primitive data types, unqualified data types and qualified data types. For subschemas specifying primitive data types, unqualified data types or qualified data types the "**`unevaluatedProperties`**" property SHALL be stated as defined in this document.
[R 8|1]	The JSON schema file names SHALL NOT contain a version information. Differences in versions are only indicated by $id and the folder structure in which the JSON schema artefacts are located.
[R 9|1]	Each JSON schema being published by user groups or standardisation organisations SHALL contain an identifier for the schema in the appropriate $id URI property. JSON schema exports that are only used in a closed environment (e.g. for testing) do NOT NEED to contain the $id property. The URI SHALL follow the following format: **`"$id": "<basepath>/<version>/<BIE>"`** with <basepath> identifying the originator. For UNECE artefacts that is "`https://service.unece.org/trade/uncefact/json-schema`" <version> in the UNECE publication format e.g. "D22A" **<BIE>** with one - distinct name for each document ABIE without a file extension - name for all BBIE components: "BasicComponents" - distinct name for every RDM set of Library ABIE components - distinct name for each extension collection The JSON schema file name SHALL be build with the following format: **<originator>-<abbreviation>.json** with **<originator>** identifying the originator. For UNECE artefacts

	it SHALL be **UNECE**. - **<abbreviation>** identifying the RDM set of Library ABIE components
[R 10|1]	The BasicComponents JSON schema file SHALL contain all subschemas for primitive data types, unqualified data types as well as qualified data types.
[R 11|1]	A property is a name/value pair inside a JSON object. The property name is the key or name part of the property. The property value is the value part of the property.
[R 12|1]	JSON property names SHALL be derived from Dictionary Entry Names (DEN). In e.g. in a BBIE the DEN contains the DEN of the surrounding ABIE, it SHALL be removed. If by applying the NDR rules words in the DEN are duplicated, the duplication SHALL be removed.
[R 13|1]	Any special characters such full stops . and underscores _ SHALL be removed from the underlying Dictionary Entry Name. If a digit (0-9) was before and another digit after the white space, the white space SHALL be replaced by a hyphen -.
[R 14|1]	JSON property names SHALL be lower camel-cased ASCII strings and JSON schema compliant: The character after a white space shall be a capital letter. Capital letters in the DEN SHALL NOT be kept.
[R 15|1]	The abbreviations and acronyms SHALL be used as defined in Table 4. [R 14|1] SHALL be taken into account.
[R 16|1]	The Object Class Term **"Identification Scheme"** SHALL be represented as **"Scheme"**. [R 14|1] SHALL be taken into account.
[R 17|1]	Primitive data types (PDT) SHALL be represented in JSON schema, as stated in Table 6. They SHALL be placed under **$defs/pdt/**.
[R 18|1]	Unqualified data types SHALL be represented in subschemas. **"Type"** as part of the Dictionary Entry Name SHALL be retained.
[R 19|1]	The CCTS content property SHALL be represented in a subschema with the name **"content"**. Its data type SHALL use the underlying PDT. The content-property SHALL be required.
[R 20|1]	Property names of supplementary components SHALL NOT repeat the JSON subschemas property name.
[R 21|1]	Supplementary components may reference to code lists and/or identification schemes. In this case the JSON property SHALL reference the appropriate code list or identification scheme as defined in section 3.5.5 Other Qualified Data Types.
[R 22|1]	Unqualified data types SHALL be represented in subschemas as shown in Table 7. The **title** and **description** properties are not shown in the following table. Instead they are indicated with the placeholder **<title and description>** as those can change over time. They SHALL be published in alignment with rules [R 4|1], [R 5|1], and [R 6|1]. They SHALL be placed under **$defs/udt**.
[R 23|1]	The **"Date Mandatory_ Date Time. Type"** SHALL be replaced by the **formattedDateTimeType**.
[R 24|1]	The **"Time Only_ Formatted_ Date Time. Type"** SHALL be replaced by the **formattedDateTimeType**.
[R 25|1]	The **"Formatted_ Date Time. Type"** SHALL be represented as follows. **"formattedDateTimeType": {** **<<title and description>>** **"oneOf": [** **{ "type": "string", "format": "date-time" },** **{ "type": "string", "format": "time" },** **{ "type": "string", "format": "date" },** **{ "type": "string", "format": "duration" },** **{ "type": "object",** **"properties": {**

	<pre>"content": { "type": "string" },
	"format": { "$ref": "UNECE_UNTDID2379-JSON.json#/$defs/codeList/untdid2379JsonType" }
	},
	"required": ["content", "format"]
	}
	]
	}</pre>

[R 26|1]	Based on the code list **"UNTDID 2379"** an additional code list **"UNTDID 2379 json"** SHALL be specified. All format definitions that are already represented in their meaning by existing JSON date and time formats SHALL be omitted. This code list SHALL be maintained in accordance with UNTDID 2379. It is represented in R 26.
[R 27|1]	Each QDT that does not fall under section 3.5.4 SHALL be restricted according to its definition applying the method described in section 3.6.1.
[R 28|1]	Each QDT SHALL be represented in a subschema. If code or id values are specified locally, they SHALL be as a oneOf combination of const definitions. They SHALL NOT be specified as enum arrays. Each code value SHALL be represented as a string type. If the values of codes and ids are organised in code and identification schemes the corresponding JSON schema SHALL refer to the appropriate code list or identification scheme.
[R 29|1]	Each code list and identification scheme SHALL be specified in a separate JSON schema file. A JSON schema file SHALL be created for each code list and identification scheme being used. Its name SHALL represent the name of the code list or identification scheme and SHALL be unique with the following form: **<Code List Agency Name>_<Code List Name or Identifier>.json** **<Identification Scheme Agency Name>_<Identification Scheme Name or Identifier>.json** Where: • All special characters SHALL be removed from the name. A period **.** in the version number is replaced by the letter **p**. • <Code List Agency Name> – Agency that maintains the code list. • <Identification Scheme Agency Name> – Agency that maintains the identification scheme. • <Code List Name or Identifier> – If a code list identifier exists in the UNTDID, the identifier is given in the format **UNTDID<identifier>**. Else the code list name is stated as assigned by the publishing agency. • <Identification Scheme Name or Identifier> – If an identification scheme identifier exists in the UNTDID, the identifier is given in the format **UNTDID<identifier>**. Else the identification scheme name is stated as assigned by the publishing agency. The file SHALL be placed in a subfolder codelists of the export path. The $id property SHALL reflect this subfolder structure.
[R 30|2]	It is a clear goal to keep the JSON schema artefacts as compatible with code lists and identification schemes as possible. For this reason the code list version and identification scheme version is neither part of the .json filename nor part of the type name. But it is part of the $id, so that JSON schema files can be used for differentiating versions if needed. If for some reason more than one version of a code

	list or identification scheme needs to be used in a specific scenario, the **<Code List Version>** or **<Identification Scheme Version>** SHOULD be added to the file name in the following format: **<Code List Agency Name>_<Code List Name or Identifier>_<Code List Version>.json** **<Identification Scheme Agency Name>_<Identification Scheme Name or Identifier>_<Identification Scheme Version>.json**
[R 31|1]	The **description** property of the JSON schema specifying a code or identifier list SHALL list the copyright notice information as defined in the CCL. This includes the code or identifier list name, code or identifier list agency, code or identifier list version, and copyright information.
[R 32|2]	The **title** property of the subschema specifying the **const** definitions holding the values of a code or identifier list SHOULD be the code name value in English language. The **description** property of the subschema specifying the **const** definitions holding the values of a code or identifier list SHOULD be the code definition value in English language.
[R 33|1]	Code lists SHALL be represented in a subschema of the corresponding schema file with the following naming convention: **$defs/codeList/<Code List Name or Identifier>Type** with <Code List Name or Identifier> – If a code list identifier exists in the UNTDID, the identifier is given in the format untdid<identifier>. Else the code list name is stated as assigned by the publishing agency with special characters removed.
[R 34|1]	Identification schemes SHALL be represented in a subschema of the corresponding schema file with the following naming convention: **$defs/identificationScheme/<Indentification Scheme Name or Identifier>Type** with < Identification Scheme Name or Identifier> – If an identification scheme identifier exists in the UNTDID, the identifier is given in the format untdid<identifier>. Else the code or identification scheme name is stated as assigned by the publishing agency with special characters removed.
[R 35|1]	Restrictions to CCTS objects SHALL be represented in a subschema as follows: Cardinalities • From 0..1 to 1..1 • From 0..1 to 0..0 (forbidden) • From 0..unbounded to 0..n with n < unbounded • From 0..unbounded to n..unbounded Restriction of value ranges Restriction of enums
[R 36|1]	The BasicComponents SHALL define a JSON subschema for extension as follows:

	`"$defs": {`
	`  "extensibleType": {`
	`  "patternProperties": { "^x-": true}`
	`  }`
	`}`

[R 37|1]	The base of all JSON schema exports SHALL be the RDM level. This means that each underlying CCL basic data type SHALL be profiled and contextualised according to the RDM definition. Only data types that are used in an RDM SHALL be exported.

[R 38|2]	A user community may decide to create "snapshot" JSON schema artefacts for a specific subset of the CCL. A "snapshot" JSON schema artefact SHALL contain all relevant data types that are needed to define the subset. The "snapshot" JSON schema artefact MAY contain additional restrictions and extensions.
[R 39|1]	A UNECE publication SHALL provide a library export on a server being able to handle the necessary requirements for a global community accessing the published artefacts. In addition, UNECE SHOULD provide an additional snapshot export for each contextualised document ABIE.
[R 40|1]	Each ABIE SHALL be represented in a JSON subschema. ABIEs that are marked as deprecated from a former version SHALL NOT be represented in a JSON subschema.
[R 41|1]	All ABIE representations in JSON subschemas SHALL include a reference to the **`extensibleType`**.
[R 42|2]	Extension property names SHOULD follow the same naming conventions as defined in this technical specification.

[R 43|1]	The BasicComponents SHALL define a JSON subschema for resource based data exchange as follows:
	`"$defs": {`
	`  "resourceType": {`
	`  "type": "string",`
	`  "format": "uri"`
	`  }`
	`}`

[R 44|1]	All ASBIEs whose ABIEs contain an identifier SHALL be modelled using an **`oneOf`** choice between the **`resourceType`** and the associated ABIE. All other ASBIEs SHALL be referenced directly. In both cases, the defined cardinality SHALL be observed.

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6 Appendix C: Glossary

Term	Definition
ASCII	American Standard Code for Information Interchange
ABIE	Aggregate Business Information Entity – a term from CCTS that describes an information class such as “consignment”
API	Application Programming Interface – a term that references a machine-to-machine interface.
ASBIE	Association Business Information Entity – a term from CCTS that defines a directed relationship from source ABIE to target ABIE – eg “consignee” as a relationship between “consignment” and “party”
B2A	Business-to-Administration
B2B	Business to Business
BBIE	Basic Business Information Entity – a term from CCTS that describes a property of a class such as party.name
BIE	Business Information Entity
CCL	Core Component Library
CCT	Core Component Type
CCTS	Core Component Technical Specification – a UN/CEFACT specification document that described the information management metamodel.
CDT	Core Data Type. A value domain for a BBIE that is a simple type such as “text” or “code”
DEN	Dictionary Entry Name
EN16931	Semantic data model of the core elements of an electronic invoice (the European Norm).
HATEOS	Hypermedia as the Engine of Application State
IETF	Internet Engineering Task Force
IRI	Internationalised Resource Identifiers – a version of the IETF URI specification that support international character sets.
JSON	JavaScript Object Notation – an IETF document syntax standard in common use by web developers for APIs.
JSON-LD	JSON-Linked Data – a JSON standard for linked data graphs / semantic vocabularies.
NDR	Naming & Design Rules – a set of rules for mapping one representation (eg RDM) to another (eg JSON-LD)
OpenAPI	An open source standard, language-agnostic interface to RESTful APIs.
OWL	Web Ontology Language
PDT	Primitive data types
PHP	Hypertext Preprocessor
QDT	Qualified Data Type. A value domain for a BBIE that is a constrained version of a CDT. Most often used with the “code” type – for example “country_code”
RDF	Resource Description Framework – a W3C semantic web standard
RDFS	RDF Schema – an XML schema for RDF documents.
RDM	Reference Data Model- a UN/CEFACT semantic output.
RESTful API	See REST API

Term	Definition
REST API	Representation State Transfer Application Programming Interface, a.k.a. RESTful API
RFC	Request for Comments
SDO	Standards Development Organization
SHACL	A W3C technical specification – the SHApes Constraint Language – used to validate the structure of published semantic graphs (vocabularies.)
UDT	Unqualified data type
UNCEFACT	United Nations Centre for Trade Facilitation and Electronic Business
UNECE	United Nations Economic Commission for Europe
URI	Uniform Resource Identifier – a namespace qualified string of characters that unambiguously identify a resource. AURL is one type of URI.
URL	Uniform Resource Locator – the web address of a resource.
UNTDID	United Nations Trade Data Interchange Directory
XML	Extensible Markup Language
XMI	Xml Metadata Interchange - a well established OMG standard for exchange of UML models between different tools.

1203 **Table 9 - Glossary**