Timespan and units of time

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Introduction

This paper proposes adjustments to treatment of the entity Timespan and associated elements in the beta RDA Toolkit to resolve a conflict with the IFLA Library Reference Model and to improve clarity, coherency, and consistency of the guidance and instructions.

Background

The IFLA Library Reference Model (LRM) introduces an entity for specified periods of time:

- LRM-E11 Time-span: A temporal extent having a beginning, an end and a duration. A *time-span* is a period of time that can be identified by specifying its beginning and end. The resulting duration can be associated with actions or occurrences that happened during that period of time. Even a very precise *time-span* has a measurable duration, however brief it may be.

This was implemented in RDA during the 3R Project as the entity Timespan:

- RDA Timespan: A finite period of time.

RDA removes the hyphen from the entity label to improve searchability within the RDA Toolkit.

The LRM provides attributes for Time-span beginning and end:

- LRM-E11-A1 Time-span Beginning. A value for the time at which the time-span started, expressed in a precise way in an authoritative external system to allow temporal positioning of events.
- LRM-E11-A2 Time-span Ending. A value for the time at which the time-span ended, expressed in a precise way in an authoritative external system to allow temporal positioning of events.

These were initially implemented in RDA as attribute elements, following the LRM, but are now treated as relationship elements between two timespans:

- RDA Timespan: beginning. A timespan that is the time at which a timespan starts.
- RDA Timespan: ending. A timespan that is the time at which a timespan finishes.

The LRM refers to ‘duration’ in its definition of Time-span. The same concept is given as a ‘type of extent’ in the LRM Expression attribute:

- LRM-E3-A2 Expression: extent. A quantification of the extent of the expression. The value of the extent attribute consists of three elements:
    - a type of extent (e.g., length of text, envisioned duration of performance of musical notation, actual duration of recorded performance, etc.),
    - a number,
    - and a measurement unit (words, minutes, etc.).

The LRM does not provide an attribute for ‘duration’.

RDA has a specific element for duration. It was included in RDA before the LRM was published, and before the 3R Project. The original definition was:

- A playing time, performance time, running time, etc., of the content of an expression.

It is a subtype of RDA Expression: extent of expression.

The definition was amended during the 3R Project to:

- RDA Expression: duration. An extent of expression that is a playing time, performance time, running time, or other timespan.

Discussion

Timespan granularity

The treatment of the beginning and end of a timespan as timespans in themselves is implicit in the LRM. The LRM notes that "The level of precision used can vary according to the context".

RDA provides specific options for the level of precision. For example, a Manifestation: date of publication is usually recorded as a year, for example '1964'. This is clearly a timespan, with a conventional beginning of '1 Jan 1964' and ending of '31 Dec 1964' (in the Gregorian calendar).

But the day '1 Jan 1964' is also clearly a timespan, with a conventional beginning of '0.00 hours on 1 Jan 1964' and ending of '24.00 hours on 1 Jan 1964'. In turn, the beginning of the beginning hours timespan can be expressed in minutes, and its beginning can be expressed in seconds, and so on. In principal, the iteration of beginning or ending timespans can be carried out down to the finest level of granularity of units of time, with each timespan being recorded in terms of the next finer unit. In theory, iteration terminates at the quantum level of physics, but this level of 'precision'[1] is unlikely to be relevant to the scope of RDA.

The RDA treatment of beginning and ending as relationship elements requires inverse elements:

- RDA Timespan: beginning of. A timespan that starts at the time that is a timespan.
- RDA Timespan: ending of. A timespan that finishes at the time that is a timespan.

These elements were added to RDA in the September 2020 release of RDA Toolkit.

It is apparent that the RDA treatment of beginning and ending as timespans implies that RDA Timespan: beginning and RDA Timespan: ending are element subtypes of RDA Timespan: part timespan, and that RDA Timespan: beginning of and RDA Timespan: ending of are element subtypes of RDA Timespan: part of timespan.

The definitions reinforce the concept that 'the time' is a timespan. The definite article indicates a cardinality of one and one only beginning and ending per timespan; apparent differences can only be a result of granularity.

This supports rich associations between dates and other timespans. For example:

- Jane Doe has date of birth 1 Jan 1964
- 1 Jan 1964 is date of birth of Jane Doe
- 1 Jan 1964 is beginning of 1964

[1] Expressed as an uncertainty relationship. This model also applies to the entity Place, which is an "extent of space" that is usually collapsed to a surface that is defined with two measurement dimensions.

    - 1 Jan 1964 is part of timespan 1964
- 1964 is date of publication of The book of Janes

Calendrical units

RDA guidance and instructions make frequent use of terms for calendrical units of time to specify the level of precision in an unstructured or structured description. For example:

- Date of birth may also include the **month** or **month** and **day** of a person's birth.
- Record a value for a **year** that is known from another source of information.

These terms are not defined in RDA.

The RDA Glossary omits terms that are used in the vernacular of the language of RDA Toolkit. It is safe to assume that the concepts of 'year' and 'day' are universal in the real world because their definitions are based on the observation of physical phenomena: a complete orbit of the Sun, and a complete rotation of the Earth. The intermediary concept of 'month' is based on physical phenomena, the complete orbit of the Moon, and cultural resolutions of the problems of fractional numbers of 'days' needed to specify accurately the larger calendrical unit 'month', as well as fractional numbers of 'months' to specify 'year'.[2] Concepts broader than 'year' are governed by choice of hierarchies of whole numbers of 'years'. For example, 'decade', 'century', and 'millennium' are exponential decimal numbers of years: 10, 100, and 1000 respectively. Different cultural numbering systems result in distinct hierarchical concepts that are also broader or narrower than concepts in other systems. Concepts narrower than 'day' are defined by clocks (time-measuring devices) influenced by culture as well as mechanics. Concepts narrower than 'hour' are usually confined to scientific definitions, including 'second' which is a 'base' unit in this context.[3]

The assumption of vernacular use of calendrical terms in RDA guidance and instructions is not justified in a context of internationalization within the scope of RDA. RDA is intended for the description of 'recorded memory' in the form of items found in the collections of libraries and other cultural heritage organizations. RDA excludes detailed coverage of 'subject' metadata. The instructions for recording values of dates of resource production events, from work to item, and dates of agent lifecycle events, are better prepared for further internationalization if calendrical terms are defined within the RDA Glossary.

Recommendation 1: Add terms for calendrical units of time to the RDA Glossary.

The RDA Glossary is generated from the labels of concepts in RDA vocabulary encoding schemes. RDA Terms is a catch-all VES for terms that require Glossary entries but are not in a VES associated with an RDA element.

A draft set of terms and definitions is given in the Appendix.

Option 1A: Add calendrical terms to a new RDA vocabulary encoding scheme for units of time.

This option provides better utility with RDA Toolkit. A structured list of terms is inserted in relevant instructions as part of an automated process and links to definitions and notations use standard templates and boilerplate.

Option 1B: Add calendrical terms to RDA terms.

[2] Wikipedia article: https://en.wikipedia.org/wiki/Month
[3] Wikipedia article: https://en.wikipedia.org/wiki/Second

This option is lower cost. Terms used within guidance and instructions are marked in the Content Management System, although actionable links to the Glossary are not yet developed. This utility also applies to Option 1A.

Duration

The LRM mentions 'duration' as a characteristic of Time-span and of Expression (via extent of expression).

The 3R Project accommodated the existing element for 'duration' as a relationship element between Expression and Timespan. The LRM suggests that 'a beginning, an end, and a duration' are the defining characteristics of a timespan, but hints that duration is derived from the values of beginning and end. This is reinforced by the definition in the most recent version of the CIDOC Conceptual Reference Model with which the LRM is ultimately aligned.[4] The scope note for CRM E5 Time-span says it does "not convey any meaning other than a positioning on the 'time-line' of chronology". It is the beginning and end that effectively define a timespan.

This suggests that duration of itself should not be modeled as a timespan. Instead, it should be an attribute element with values that are unstructured or structured descriptions that use units of time. This fits with the aspect-quantity-unit model to be incorporated into RDA extent elements as a post-3R Project development.

Recommendation 2: Revert Expression: duration to be an attribute element.

This involves deprecating the inverse element Timespan: duration of and removing it from RDA Toolkit.

The definition of Expression: duration should be amended to remove the phrase 'or other timespan' and should be rephrased for clarity and consistency:

Expression: duration. An extent of expression that is a number of units of time for playing, performing, or running the content.

Recommendation 3: Add a list of calendrical units of time to the instructions for Expression: duration.

This can be a list generated from the VES if option 1A is chosen, or an editorial list if option 1B is chosen. The context is a structured description that uses controlled terms for units and an associated quantity, for example '5 hours 45 minutes'. The content will replace the current instructions for Structured description that refer to Timespan.

Recommendation 4: Ensure that standard abbreviations for units of time are included in RDA Toolkit.

Standard abbreviations and symbols for units of time should also be accommodated. This activity can be included in the ongoing development of Community resources and string encoding schemes.

Recommendation 5: Extend the list of calendrical units of time to include standard scientific terms for concepts narrower than 'second'.

Concepts down to the granularity of 'microsecond' will be of use for describing the duration of resources in special collections.

[4] http://cidoc-crm.org/sites/default/files/CIDOC%20CRM_v.7.0_%2020-6-2020.docx

The list name should be generalized to ‘units of time’ and the wording of guidance and instructions amended accordingly. The is an editorial task.

Recommendation 6: Add appropriate cross-references between the instructions for Expression: duration and Expression: date of capture.

This will clarify the difference between the duration of a recorded performance expression and the timespan during which the recording was made. The phrasing of the references will follow the standard editorial template used in Prerecording sections.

Impact

Recommendations 1 and 2 require changes to RDA Reference. It is unlikely that Timespan: duration of has been used in RDA applications.

All recommendations improve the clarity and consistency of the guidance and instructions for dates and other timespans, and for duration as an extent element.

Changes to RDA instructions fall within established templates and phrasing and do not require special development.

There is no impact on Expression: details of duration, which is soft-deprecated in favour of the unstructured description method of Expression: duration.

Recommendations and options

Recommendation 1: Add terms for calendrical units of time to the RDA Glossary.

Option 1A: Add calendrical terms to a new RDA vocabulary encoding scheme for units of time.

Option 1B: Add calendrical terms to RDA terms.

Recommendation 2: Revert Expression: duration to be an attribute element.

Recommendation 3: Add a list of calendrical units of time to the instructions for Expression: duration.

Recommendation 4: Ensure that standard abbreviations for units of time are included in RDA Toolkit.

Recommendation 5: Extend the list of calendrical units of time to include standard scientific terms for concepts narrower than ‘second’.

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Appendix: Units of time

The following table gives proposed terms and definitions for calendrical units of time covered by the original RDA Toolkit.

Term	Definition	Note
second	A unit of time that is 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom.	
minute	A unit of time that is 60 seconds in duration.	
hour	A unit of time that is 60 minutes in duration.	
day	A unit of time that is 24 hours in duration.	
week	A unit of time that is 7 days in duration.	
month	A unit of time that is approximately 4-5 weeks in duration.	
year	A unit of time that is approximately 12-13 months in duration.	A Julian year is 31,557,600 seconds. A year is also approximately 365-366 days in duration.
decade	A unit of time that is 10 years in duration.	
century	A unit of time that is 10 decades in duration.	
millennium	A unit of time that is 10 centuries in duration.	