RIF-CS

RIF-CS and CERIF Alignment Study

A report for the Joint Information Systems Committee-funded RIF-CS project

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Authors	Emma L. Tonkin, Rosemary Russell
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1. Aim

This study aimed to carry out a brief high level comparison of the RIF-CS and CERIF standards, and to assess the amount of overlap, as well as the feasibility of mapping and the potential usefulness of a completed mapping. The study includes brief overviews of both standards, in order to compare functions covered. CERIF experts were contacted for comment during a CERIF-focused event in Bath. The latest version of the CERIF standard (Version 1.3) has been reviewed, along with the prior version (CERIF, 2008), for the purposes of this study.

Both RIF-CS and CERIF are, broadly speaking, standards for information exchange. Both function within the research domain. However at first glance the two standards appear to have very different remits: RIF-CS appears to be focused on listing services, whereas CERIF covers a much broader range of business processes.

Given the apparent differences between standards, one significant question for this study is the need for alignment of these standards. We have consequentially explored:

- a candidate use case
- the current level of use of that use case
- the relevance of a CERIF mapping for that use case.

We have also discussed the technical feasibility of a mapping in this context, as well as some high-level discussion of the feasibility of a CERIF/RIF-CS mapping in the general case.

2. Background

The Registry Interchange Format – Collections and Services (RIF-CS)[1] Schema was developed as a data interchange format for supporting the submission of collections metadata to a collections service registry. The schema has an accompanying set of vocabularies. It was developed by the Global Registries Initiative (GRI), a partnership of the OCKHAM Initiative (US), IESR (UK) and ANDS (Australia). RIF-CS is a profile of ISO 2146:2010 Information and documentation – Registry services for libraries and related organizations. Data encoded in RIF-CS can be converted to other XML-based schemas such as the DCMI Collections AP and vice versa.

In point of fact, RIF-CS refers only to the XML format used for communications with a registry, and is based on ISO 2146:2010 (ANDS, 2011). ANDS opted to use the ISO 2146:2010 (Registry Services for Libraries and Related Organisations) information model within the RIF-CS format.

ANDS, the Australian National Data Service, are tasked with building a Research Data Commons (ARDC) containing research resources. The intent is to 'support the discovery of, and access to, research data held in Australian universities, publicly funded research agencies and government organisations for the use of research [...] enabl[ing] the construction of a range of ICT utilities to capitalise on and ensure greater use and re-use of existing data resources, as well as better management of new data generated in Australian research'[2].

[1] http://www.globalregistries.org/rifcs.html
[2] http://ands.org.au/ardc.html

There are various use cases mentioned on the ANDS ARDC resource footnoted above: notably,

- make available feeds of data collection descriptions from a range of public sector agencies
- federate and make visible the Data Commons
- enable data/metadata management and sharing for research producing institutions
- enable capture of data and metadata from research instruments, and
- allow users to fully exploit the data held in the commons

The Common European Research Information Format (CERIF) [3] is a standard for managing and exchanging research data, i.e. information about researchers, projects, outputs and funding that arises from the research process. It provides a data model that can be used to describe the research domain, including relationships between the constituent parts. euroCRIS is the official custodian of CERIF, with development carried out by the CERIF task group. It is used mainly in Europe, with more recent activity in North America and a range of other countries. Russell (2012) reviews current levels of CERIF usage in the UK, finding that many organisations making use of CRIS systems make some use of CERIF as a standard, typically via commercial CRIS systems. Whilst many users/managers consider the standard to be important, it has attracted limited engagement.

In principle, then, the distinction between the two is clear: CERIF is a much more extensive standard, capable of describing a broad variety of entities, and including a large number of cases and exceptions. Furthermore, unlike RIF-CS, CERIF does not explicitly aim to provide functionality comparable to service registry solutions like IESR. That is, the primary use case of RIF-CS—service description and registration—is not an explicitly handled use case in CERIF as it currently stands.

The first key question of this report, therefore, is the technical feasibility of achieving such a mapping at all—not solely between RIF-CS and CERIF, but more meaningfully, between the data models underlying RIF-CS and CERIF.

3. Exploring use cases

3.1. Use case: Registering and mapping services

A candidate use case for RIF-CS might look something like the following:

A university has developed a large collection of data, along with a number of research outputs. The university wants to submit their data collection to a 'Research Data Commons', thus publicising the existence of their research data collections (ANDS, 2011). There are several ways of doing this; naturally, it would be possible to manage this through a series of forms, sent perhaps by email to the Data Commons administrator. However, using RIF-CS it is possible for the university to automatically exchange a detailed, machine-readable description of a collection or set of collections with the Data Commons.

[3] http://www.eurocris.org/Index.php?page=homepage&t=1

Following this, it is possible for the Data Commons to list the collection as part of the data indexed, along with relevant metadata such as the author/author's agency, name and collection. It is also possible for links to the collections, services held within the collections, and specific data objects to be exposed.

If an individual is looking for a collection of information about a given topic, therefore, reviewing the data made available to the Research Data Commons will help him to decide which collections may be relevant, as well as where and how the collection may be retrieved.

3.2. Exploring the collection use case

The ANDS aims to provide a central resource describing the disparate research collections made available by researchers and research organisations throughout Australia. In order to achieve this, organisations must submit their data in RIF-CS format. As of last year, Liu et al. (2011) suggest that well over 1400 data collections were made available, suggesting that this use case is well-explored and validated by practical usage.

An example XML file provided by the ANDS is included in this report (Appendix 1). This XML file includes representations of the 'objects' contained within RIF-CS—Collection, Party, Activity and Service (Milne et al., 2010), and provides a good practical example of the level to which these objects are specified. In brief, this example states the following:

- That there exists a **program** [a type of activity, defined in the vocabularies as 'a system of activities intended to meet a public need], about which a certain quantity of information points is given—the name of the programme is given according in its full and abbreviated form alongside a description and information regarding funding. An actionable URI identifier is given.
- That there exists a **project** with a specified start [and, according to the vocabulary document, end date], with a given description and identifier.
- That there exists a **collection** with a given identifier (here a handle.net identifier), name, url location, a number of supported access methods and an identified managing authority
- That there exists a **person** (a type of party)—note that the vocabulary documentation allows 'person' to be 'an identity assumed by one or more human beings. The person has a given first and lastname, has a management responsibility over identified objects, and a set of 'existenceDates' (introduced as part of RIF-CS v1.3.0, in late 2011).

3.3. Reviewing the service/collection discovery example

Reviewing this specific use case, perhaps the most striking single aspect of the example file is its focus on specific details—for example, from the perspective of a network or system administrator, the 'existenceDates' (i.e. birthdate and date of death) of an individual would seem to be an extraneous detail at best. Indeed, from the perspective of a system administrator the appearance of an endDate would seem to sharply limit the usefulness of this information overall, as it demonstrates that the record is out of date and that the individual/group identified is no longer managing the service. The online documentation clarifies the appearance of this information as follows:

> Existence dates for parties support the ARDC Party Infrastructure. Knowing the birth date or year of a researcher makes it easier to match party descriptions to the right person or organisation in the NLA's Trove-People and Organisations database.[4]

This is one sign that RIF-CS, while it fulfils a pragmatic use case in this instance, has the potential to provide detailed information about all sorts of entities and to be used in a broader set of use cases—to support visualisations, such as the construction of timelines, to support mining and machine learning by making available clear information about individuals, and so forth.

As implementation moves in this direction it becomes clear that RIF-CS can be used in a manner approaching traditional CERIF use-cases relating to research information management, as an interoperable mechanism enabling trustworthy/authoritative data regarding research activity, researchers and relevant initiatives to be stored, shared and built on.

Whilst the benefits of such a system have been covered in detail elsewhere, it introduces difficulties that are less visible in the simpler use-case; for example, there is a risk of duplication of effort between RIM systems, and of fragmentation (for example, the use of multiple incompatible or incompletely mapped persistent identifiers or datasets, which would amongst other things defeat the stated aims of enabling identity/name disambiguation (Stevenson, 2011). This being the case, this document will cover two cases: the use case discussed above, as represented in CERIF, and the general case.

4. Exploring the feasibility of a mapping

4.1. Preliminary remarks

Because the general case is extremely extensive in scope and difficult to specify in any detail we will instead discuss in broad terms the vocabulary set provided for the RIF-CS registry schema, and identify candidate mappings where they are available; this leaves us with a general idea of where the weak points may be found and, in some cases, how they may be tackled. The extensibility of CERIF means that rather than being a question of whether a mapping may be achieved, the questions are how it may be achieved, the level of customisation and decision-making involved in the process, the lossiness of a candidate crosswalk, and how valuable the result might prove to be.

In the simple case, RIF-CS has an enviable elegance—it provides enough information to achieve a given set of aims, whilst remaining lightweight and readable. One potential concern with more complex use cases in general is that this simplicity may be lost. CERIF is 'often described as a very complex standard' (Russell, 2010), and not without reason. Taken as an aggregate standard it is both extensive and complex. As a consequence CERIF is often applied only in part (to suit a given use case or set of use-cases).

[4] http://www.ands.org.au/guides/cpguide/cpgexistencedates.html

4.2. RIF-CS and CERIF: Mapping for service discovery

The question, then, is how to represent the following information in CERIF:

- A **program**, 'a system of activities intended to meet a public need', with a certain name presented in full and abbreviated form, with a description, URI and funder information.
- A **project** with a specified start [and, according to the vocabulary document, end date], with a given description and identifier.
- A **collection** with a given identifier (here a handle.net identifier), name, url location, a number of supported access methods and an identified managing authority
- A **person** (a type of **party**)—an identity assumed by one or more human beings, with a given first and lastname, has a management responsibility over identified objects, and a set of 'existenceDates'.

The CERIF base entities are Person, Organisation Unit and Project. Of these, either organisation unit or person is required for the purpose of representing the RIF-CS 'party/person' object. The Project entity in CERIF relates to project, person, organisation, publication, funding programme, service, and so forth, thus covering both **program** and **project** in RIF-CS. The difficulty here is representing **collection**, specifically the service endpoint—i.e. it is possible in CERIF to state that a project involving certain individuals has resulted in certain outputs, but CERIF does not currently provide explicitly for the description of service-oriented architecture elements within this framework.

One could link outputs via CERIF's link entity facility (i.e. providing the semantics 'a group of **Person** entities, collectively funded by **FundingProgramme**, have authored the following **ResultPublication**s'). However, this is an unwieldy and complex (albeit relatively detailed) approach to describing a **collection** in the RIF-CS sense, compared to its relatively compact representation within RIF-CS. A natural alternative approach might be to describe the collection as a `cfResultProduct`; however, this term is intended to refer to a dataset rather than, more broadly speaking, a 'collection'.

4.3. Collections and datasets

It is perhaps worth a brief digression to explore the various definitions of the terms 'collection' and 'dataset'. RIF-CS takes a broad view of the term 'collection', describing it as an 'aggregation of physical or digital objects' [5]. Ball (2009) presents a candidate set of terms for a nominal 'scientific data application profile', including the following terms (left; compare with DC Collections AP terms, right):

[5] `http://www.ands.org.au/guides/rif-cs-awareness.html`

Scientific data application profile	DC Collections AP
Dataset identifier	Collection identifier
Dataset name	Collection title Alternative title
Dataset version	
Dataset date	Data collection accumulated
	Date items created
	Collection type
	Item type
	Item format
Metadata record identifier	
Metadata record date	
Metadata scheme name	
Metadata scheme version	
Project/study/series name	Super-collection Associated collection Associated Publication Catalogue or index
Project/study/series status	
	Audience
Agent	Collector Owner
Agent contact details	Collector Owner
	Accrual Method
	Accrual Periodicity
	Accrual Policy
	Custodial history [provenance]
Rights/restrictions	Access rights/ Rights
Archiving Location	Is Located At Is Accessed Via
File formats	
Storage medium	
Size [in bytes/mb/etc]	Size
Data quality information	
Data preview [graphical]	
Dataset language	Language
Dataset status	

Whilst the DC Collections AP is in no sense a definitive document, it is clear that it differs in some respects to the candidate scientific data application profile. Notably, the Collections AP

provides more detail about the collection, its relation to other collections, its provenance and its likely audience, whilst providing less information destined for index presentation purposes (such as graphical preview). Such ambiguities in definition, scope and intended patterns of use rapidly become significant where the intention is to provide detailed information about the collection/ dataset. As is often the case, such ambiguities may be addressed through appropriately detailed use cases and carefully managed requirements.

4.4. RIF-CS as a machine-to-machine interface

A further difficulty for a mapping of this kind at this moment is the description in CERIF of a collection/dataset as an object with a set of supported [technical] access methods, i.e. the service-level description aspect of the use case. On one level RIF-CS performs a task similar to that of SOAP/WSDL[6], which is to say, providing an adequate machine-readable description of service availability, endpoints, protocols and so forth, such that a machine-to-machine service may use the information to make use of the information held within that service. Whilst this is a task that CERIF could in principle be extended to achieve, such an extension would be required before this use case could be successfully implemented.

5. The general case: exploring RIF-CS/CERIF crosswalks

As the entities identified in RIF-CS (i.e. individual, project, organisational unit) generally appear both in RIF-CS and in CERIF, there is a good likelihood that a clear (albeit potentially lossy) mapping may be achieved. By this is meant the following: entities, concepts and in some cases concepts and relationships exist by default, in some form, in both systems. This has the effect of rendering a mapping possible—however, even terms that exist in common may differ sufficiently to stop us from drawing a simple equivalence between encodings.

Consequentially, the successful use of such a mapping is likely to depend on a known technical and social context of use, enabling shared understanding of term extent, usage and encoding, as well as available vocabulary and semantics.

5.1. 'Profile' and 'Extension': encoding shared practice

In some parts of this document, the term 'extension' is used to refer, broadly speaking, to the use of additional vocabulary, classification terms, links (relations), or simply novel patterns of use of the CERIF standard as it is currently defined. This usage of the term 'extension' is likely to contravene technical definitions of the term in the field. Therefore we provide a definition of the term as we use it here: if any piece of terminology, class, link etc is used—albeit in many cases in a perfectly standard-compliant manner—in a manner that would not commonly be seen in typical CERIF implementations, or in a manner that would not in itself be correctly picked up or displayed by systems making use of this CERIF data, then that usage is effectively an extension. Such an extension introduces a new 'profile' of CERIF usage, which is to say, a way in which CERIF can be used to achieve another use case or set of aims, and it is axiomatic to

[6] WSDL – Web Services Definition Language – http://www.w3.org/TR/wsdl

the adoption of that profile that work—in all probability a significant quantity of work—be put into GUIs, documentation, etc. in order that this 'profile' may be used effectively.

The authors do not imply that, in order to develop towards a given usage pattern, CERIF must be developed in a given manner. This document is intended only to identify some possibilities (a 'strawman mapping').

6. RIF-CS to CERIF: Potential crosswalks

In the following section we review vocabulary terms from RIF-CS[7], identifying possible crosswalks into CERIF. Note: * denotes that there is known ambiguity in this term, whilst † indicates that the term may require extension to CERIF. A further set of problems exist resultant from the difference in models between the two systems; these are not covered here in detail, as this is a broader modelling problem and any analysis on this topic has as a prerequisite the completion and availability of a set of appropriate use cases for guidance.

6.1. Activity

	RIF-CS	CERIF
Term	award	2nd level entity `cfPrizeAward` (`cfPrize`) `cfPrizeAward_Classification` (`cfPrize_Class`)
Semantic	something given to recognize excellence in a certain field	

	RIF-CS	CERIF

Term	course	2nd level entity
		`cfCurriculumVitae`
		`cfCurriculumVitae_Classification`

Semantic	education imparted in a series of lessons or meetings	

	RIF-CS	CERIF
Term	event	2nd level entity `cfEvent` (`cfEvent`)
Semantic	something that happens at a particular place or time as an organized activity with participants or an audience	

[7] `http://services.ands.org.au/documentation/rifcs/guidelines/RIF-CS.html`

	RIF-CS	CERIF
Term	program	2nd level entity cfFunding (cfFund)
Semantic	system of activities intended to meet a public need	

	RIF-CS	CERIF
Term	project	CERIF core entity cfProject (cfProj) cfStartDate (timestamp) cfEndDate (timestamp)
Semantic	piece of work that is undertaken or attempted, with a start and end date and defined objectives	

6.2. Collection type

	RIF-CS	CERIF	
Term	catalogueOrIndex	Arguably may be described through cfResultProduct, although this is practically intended to record datasets	*
Semantic	collection of resource descriptions describing the content of one or more repositories or collective works		

	RIF-CS	CERIF	
Term	collection	Arguably may be described through cfResultProduct, although this is practically intended to record datasets	*
Semantic	compiled content created as separate and independent works and assembled into a collective whole for distribution and use		

	RIF-CS	CERIF	
Term	registry		†
Semantic	collection of registry objects compiled to support the business of a given community		

	RIF-CS	CERIF	
Term	repository	Arguably, may be described through `cfResultProduct` (see below).	*
Semantic	collection of physical or digital objects compiled for information and documentation purposes and/or for storage and safekeeping		

	RIF-CS	CERIF

Term	dataset	`cfResultProduct`
		`cfClassificationIdentifier`
		`cfClassificationSchemeIdentifier`

Semantic	collection of physical or digital objects generated by research activities	`cfResultProduct` appears to be used to encode a broad set of uses within the broad category of datasets; for example, one author suggests its use to describe a new treatment for an illness [8]. The constraint on its use is: is an appropriate classification scheme available, that can be applied for this purpose?

The CERIF for Datasets (C4D) project (Garfield et al., 2012) recently released a paper on the subject of CERIF extension to deal with research datasets. The authors suggest that the `cfResultProduct` entity be used to provide basic metadata about the dataset, although this will require extension.

6.3. Party

	RIF-CS	CERIF
Term	group	CERIF core entity `cfOrgUnit` (`cfOrgUnit`)
Semantic	one or more persons acting as a family, group, association, partnership or corporation	

	RIF-CS	CERIF	
Term	person	CERIF core entities `cfPerson` (`cfPers`) or `cfOrgUnit` (`cfOrgUnit`)	*
Semantic	human being or identity assumed by one or more human beings		

[8] `http://nusl.techlib.cz/images/Dvorak_text_EN_2011.pdf`

Note: This differs from the CERIF concept, which is effectively individual: a Person in RIF-CS is defined as an identity assumed by one *or more* human beings.

6.4. Service type †

RIF-CS terms:

create	**transform**	**search-sru**
generate (simulator)	**assemble**	**search-srw**
report (visualisation, summary)	**harvest-oaipmh**	**search-z3950**
	search-http	**syndicate-atom**
annotate	**search-opensearch**	**syndicate-rss**

As previously mentioned, these are difficult to map to CERIF without extension (see previous box regarding the term 'extension').

6.5. Description type

This section is illustrative of a concept that does occur in both CERIF and RIF-CS, but which is handled quite differently because of the dissimilar guiding use cases.

brief *

full * (see `cfDublinCoreDescription`, `cfDublinCoreTitle`, `cf*Description`)

logo †

note

rights

According to Jeffery et al. (2002) 'CERIF handles associative-restrictive metadata by placing constraints (mapped as attribute values together with temporal constraints) in the linking relations which represent the relationship between, for example, an author and a publication or a user and a publication'.

accessRights	**deliverymethod** †	**significanceStatement** †

6.6. Spatial type/geolocation *

gml OpenGIS Geography Markup Language (GML) Encoding Standard

gmlKmlPolyCoords A set of KML long/lat co-ordinates derived from GML defining a polygon as described by the KML coordinates element but without the altitude component

gpx the GPS Exchange Format

iso31661 ISO 3166-1 Codes for the representation of names of countries and their subdivisions—Part 1: Country codes

iso31662 Codes for the representation of names of countries and their subdivisions—Part 2: Country subdivision codes

iso19139dcmiBox DCMI Box notation derived from bounding box metadata conformant with the iso19139 schema

kml Keyhole Markup Language developed for use with Google Earth

kmlPolyCoords A set of KML long/lat co-ordinates defining a polygon as described by the KML coordinates element

dcmiPoint spatial location information specified in DCMI Point notation

text free-text representation of spatial location

The level of spatial detail that RIF-CS vocabularies permit is considerable, especially the variety of encoding methods, and appears to exceed that which CERIF offers in its default state. However, CERIF v.1.3 added a facility for geographical bounding:

	RIF-CS	CERIF

Term	dcmiBox
	northlimit
	eastlimit
	southlimit
	westlimit
	uplimit
	downlimit
	units
	zunits
	projection
	name
		`cfGeoBBox`
		`cfWBLong`
		`cfEBLong`
		`cfSBLat`
		`cfNBLat`
		`cfMinElev`
		`cfMaxElev`
		`cfGeoBBoxId`
		`cfDescr`
		`cfName`

Semantic	DCMI Box notation derived from bounding box metadata conformant with the iso19139 schema	

6.7. Physical address type

	RIF-CS	CERIF
Term	streetAddress	
Semantic	address where an entity is physically located	`cfPostAddress_Classification` `cfPostAddress_GeographicBoundingBox`

	RIF-CS	CERIF
Term	postalAddress	
Semantic	address where mail for an entity should be sent	`cfPostAddress`

6.8. Physical Address Part Type

	RIF-CS	CERIF	
Term	addressLine	`cfPostAddress`	*
Semantic	an address part that is a separate line of a structured address		

	RIF-CS	CERIF	
Term	text	`cfPostAddress`	*
Semantic	a single address part that contains the whole address in unstructured form		

Analogous vocabulary is present in principle but differs in semantic. Again, the presentation described in CERIF is intended to support a differing set of use cases to the (relatively presentation-focused) RIF-CS.

	RIF-CS	CERIF	
Term	telephoneNumber		†
Semantic	an address part that contains a telephone number, including a mobile telephone number		

	RIF-CS	CERIF	
Term	faxNumber		†
Semantic	an address part that contains a fax (facsimile) number		

6.9. Name type

	RIF-CS	CERIF	
Term	primary		†
Semantic	official name of the registry object		

	RIF-CS	CERIF	
Term	abbreviated		†
Semantic	shortened form of, or acronym for, the official name		

	RIF-CS	CERIF	
Term	alternative		†
Semantic	any other form of name used now or in the past as a substitute or alternative for the official name		

6.10. Name part type

	RIF-CS	CERIF	
Term	family	`cfPersName` `cfFamilyNames`	*
Semantic	last name or surname		

	RIF-CS	CERIF	
Term	given	`cfPersonName` `cfFirstNames`	*
Semantic	forename or given or Christian name		

	RIF-CS	CERIF	
Term	initial	`cfPersonName` `cfMiddleNames`	*
Semantic	a single initial		

	RIF-CS	CERIF	

Term	suffix	`cfPersonName`
		`cfPerson_PrizeAward`
		`cfClassificationSchemeIdentifier`
			*

Semantic	honours, awards, qualifications and other identifiers conferred	'The classification scheme identifier (`cfClassSchemeId`) identifies a classification scheme system internally. The unique classification (`cfClassId`) + the unique classification scheme identifier (`cfClassSchemeId`) propagate to link tables: (i.e. `cfPerson_Classification`, `cfPerson_Service`, ...). Some classification examples grouped by example schemes are: Prof., Dr, PhD, ...belonging to a scheme i.e. Academic Titles' [9]	

	RIF-CS	CERIF	

Term	title	`cfPersonName`
		`cfPerson_PrizeAward`
		`cfClassificationSchemeIdentifier`
			*

Semantic	word or phrase indicative of rank, office, nobility, honour, etc., or a term of address associated with a person	See 'suffix', above	

Name encoding practices within CERIF are currently being reviewed within committee, so this is likely to change in the future. As a consequence this segment has been left open.

6.11. Identifier type *

abn Australian Business Number

arc Australian Research Council Identifier

ark ARK persistent identifier scheme

doi Digital object identifier

handle HANDLE System Identifier

infouri 'info' URI scheme

isil International Standard Identifier for Libraries

local identifier unique within a local context

AL-ANL:PEAU National Library of Australia identifier

purl Persistent Uniform Resource Locator

uri Uniform Resource Identifier

CERIF devotes a great deal of effort to identifiers in general; however, in principle RIF-CS covers a broad variety of identifier standards, which again may indicate a philosophical difference

[9] `http://cerifinaction.wordpress.com/2012/01/26/mapping/`

between the two standards—the broader the variety of identifiers in use, generally speaking, the less clarity is available to the data consumer. Identifier policy involves a number of tradeoffs.

6.12. Electronic address type

	RIF-CS	CERIF
Term	email	`cfElectronicAddress`
Semantic	string used to receive messages by means of a computer network	*'A URI can identify an abstract or physical resource, and its semantics depend on the Classification and Classification Scheme entities, where each classification entity belongs to a classification scheme and has its own URI. Example: an electronic address contains an `eAddrID="eAddrId1"`, where `"eAddrId1"` belongs to the URI `"name@email.com"` which belongs to `ClassificationSchemeID="ElectronicAddressScheme1"`, which has the `URI="email"`.'* [10]

	RIF-CS	CERIF	
Term	other	`cfElectronicAddress`	*
Semantic	other electronic address	'The electronic address unique identifier (`cfEAddrId`) propagates to e.g.: `cfPerson_ElectronicAddress`, `cfOrganisation_ElectronicAddress`, `cfElectronicAddress_Classification`' (CiA, 2012)	

	RIF-CS	CERIF	
Term	url	`cfURI` `cfPers`	*
Semantic	Uniform Resource Locator		

	RIF-CS	CERIF	
Term	wsdl		†
Semantic	(service only) Web Service Definition Language		

[10] `http://www.dfki.de/~brigitte/CERIF/CERIF2006_1.1FDM/Logical_07-2007/EntityB.html`

6.13. Arg Type

	RIF-CS	CERIF	
Term	String		†
Semantic	(Service only) Indicates the value of an argument is a plain-text string.		

	RIF-CS	CERIF	
Term	Object		†
Semantic	Indicates the value of an argument is an object, most likely in serialised form		

6.14. Arg Use

	RIF-CS	CERIF	
Term	inline		†
Semantic	(Service only) Indicates the argument forms part of the base URL		

	RIF-CS	CERIF	
Term	keyValue		†
Semantic	(Service only) Indicates the argument is passed using key=value pairings in the query component of a URL		

6.15. Temporal coverage date type

	RIF-CS	CERIF
Term	dateFrom	`cfStartDate`
Semantic	start date for a temporal coverage period	The StartDate attribute represents the date or time at which this record is true. Also known as the Valid Time.

	RIF-CS	CERIF
Term	dateTo	`cfEndDate`
Semantic	end date for a temporal coverage period	The EndDate attribute represents the date or time at which this record stops to be true. Also known as the End of Valid Time.

Alternative proposed mapping: `cfDublinCoreCoverageTemporal`, if this applies to temporal coverage of the resource.*

6.16. Temporal coverage date format

	RIF-CS	CERIF	
Term	UTC	See 'W3CDTF', below.	*
Semantic	Coordinated Universal Time		

	RIF-CS	CERIF	
Term	W3CDTF	`cfDublinCoreValue`	*
Semantic	W3C Date Time Format	Recommended best practice for encoding the DCDate value is defined in a profile of ISO 8601 [W3CDTF] and includes (among others) dates of the form YYYY-MM-DD [11].	

6.17. Citation style

Harvard	**IEEE**	**AGPS-AGIMO**
APA	**CSE**	**AGLC**
MLA	**Chicago**	**ACS**
Vancouver	**AMA**	**Datacite**

	RIF-CS	CERIF	

Term	citation style	`cfCitation`
		`cfCitation_Classification`
		`cfCitation_Medium`
		`cfCitationDescription`
		`cfCitationTitle`
			*

Semantic	The style of the citation		

6.18. Citation identifier type

See 'Related information identifier type'.

[11] `http://www.dfki.de/~brigitte/CERIF/CERIF2006_1.1FDM/Logical_07-2007/EntityB.html`

6.19. Related information type

	RIF-CS	CERIF
Term	publication	`cfResultPublication` `cfResultProduct` (intended to encode datasets) `cfResultPatent` *
Semantic	any formally published document, whether available in digital or online form or not.	

	RIF-CS	CERIF
Term	website	`cfOrganisationUnit_ElectronicAddress`
Semantic	any publicly accessible web location containing information related to the collection, activity, party or service.	

6.20. Citation/Related information identifier type

ark ARK Persistent Identifier Scheme

doi Digital Object Identifier

ean13 International Article Number

eissn electronic International Standard Serial Number

handle HANDLE system Identifier

infoui 'info' URI scheme

local identifier unique within a local context

purl Persistent Uniform Resource Locator

uri Uniform Resource Identifier

issn International Standard Serial Number

isbn International Standard Book Number

istc International Standard Text Code

lissn

upc Universal Product Code

urn Uniform Resource Name

CERIF does not exclude the use of diverse identifier types, and can be used flexibly, so a broad variety of encodings/identifiers may in principle be used. However, the recommended form of identifier is the UUID [12]. RIF-CS provides for a diverse landscape of identifiers, suggesting that it is up to the community making use of RIF-CS to establish best practice.

[12] `http://uisk.ff.cuni.cz/dwn/1003/15611cs_CZ_prezentace-CERIF.pptx`

7. Entity relations and links

7.1. Activity relation type

	RIF-CS	CERIF	
Term	hasAssociationWith	(if the assertion is made of an individual) `cfPersId` - `cfPers_OrgUnit` (or `cfProj_OrgUnit`) - link The type of link may be defined separately	*
Semantic	has an unspecified relationship with the related activity		

	RIF-CS	CERIF	
Term	hasOutput	`cfResPubl` - link `cfResPat` - link `cfResProd` - link	*
Semantic	delivers materials in the related collection		

	RIF-CS	CERIF
Term	hasPart	
Semantic	Contains the related activity	

	RIF-CS	CERIF
Term	hasParticipant	Link entity: Person_Project Project_OrganisationUnit
Semantic	is undertaken by the related party	

	RIF-CS	CERIF

Term	isFundedBy	Link entity:
		`cfFacility_Funding`
		`cfOrganisationUnit_Funding`
		`cfPerson_Funding`
		`cfProject_Funding`
		`cfResultPublication_Funding`

Semantic	receives monetary or in-kind aid from the related program	

	RIF-CS	CERIF	

Term	isManagedBy	Link entity:
		`cfPerson_OrganisationUnit`
		`cfProject_Facility`
		`cfProject_OrganisationUnit`
		and so forth
			*

Semantic	is organised and/or delivered by the related party	`cfPerson_OrganisationUnit` may include: 'Affiliation, subaffiliation, head, employer, member, director, deputy director, dean, principle, head of department, group leader, manager, spokesperson, associate, fellow, reviewer, engineer, technician, function' (CiA, 2012)	

	RIF-CS	CERIF	
Term	isOwnedBy	`cfDCRightsHolder` `cfDCRightsManagement`	*
Semantic	legally belongs to the related party		

	RIF-CS	CERIF	
Term	isPartOf	Effectively inverted: Rather than 'Item is contained in project', CERIF provides 'Project_ResultPublication' (although 'Person_Project', person is linked to project).	*
Semantic	is contained in the related activity		

7.2. Collection relation type

	RIF-CS	CERIF	
Term	describes	`cfResPubl_Class` (an unnamed publication type) with appropriate `cfTerm` (Collection) and `cfClassDescr`	*
Semantic	is a catalogue for, or index of, items in the related collection		

	RIF-CS	CERIF	
Term	hasPart	hasPart and isPartOf provided as example in the context of 'Organisation Structure' scheme (CERIF, 2012). If a collection were seen as a `cfResultPublication` or as a resultProduct it could be linked in the usual way for these terms (CERIF, 2012, p. 44)	*
Semantic	contains the related collection		

	RIF-CS	CERIF	
Term	hasAssociationWith	Implied by unclassified link in CERIF, but such links usually hold some specificity by default Additional Entities suggests that `cfDCRelation`, the CERIF form of the Dublin Core Relation term, could be used here.	*
Semantic	has an undefined relationship with the related collection		

	RIF-CS	CERIF	
Term	hasCollector	`cfDCCreator` `cfDCContributor`	*
Semantic	has an undefined relationship with the related collection	Amongst the additional entities permitted by CERIF (2012, p. 46) are `cfDCCreator` and `cfDCContributor`, both taken from the Dublin Core.	

	RIF-CS	CERIF	
Term	isDescribedBy		†
Semantic	is catalogued or indexed by the related collection		

	RIF-CS	CERIF	
Term	isLocatedIn	`cfDCSource`	*
Semantic	is held in the related repository	`cfDCSource` - from Dublin Core. A related resource from which the described resource is described.	

	RIF-CS	CERIF	
Term	isLocatedIn	`cfDCSource` (see above)	*
Semantic	is held in the related repository		

	RIF-CS	CERIF	
Term	isLocationFor		†
Semantic	is held in the related repository		

	RIF-CS	CERIF	

Term	isManagedBy	`cfProject_Person`
		`cfResultProduct_Person`
		`cfResultPublication_Person`
		(with appropriate classification)
			*

Semantic	is maintained and made accessible by the related party		

	RIF-CS	CERIF
Term	isOutputOf	`cfProject_Result`[product type]
Semantic	is a product of the related activity	

	RIF-CS	CERIF	
Term	isOwnedBy	`cfDCRightsHolder` `cfDCRightsManagement`	*
Semantic	legally belongs to the related party		

	RIF-CS	CERIF	
Term	isPartOf	It is possible that `cfDCSource` may be useful for this purpose	*
Semantic	is contained within the related collection		

	RIF-CS	CERIF	
Term	supports	No CERIF equivalent appears to exist	†
Semantic	can be contributed to, accessed or used through the related service		

	RIF-CS	CERIF	
Term	isEnrichedBy	No CERIF equivalent appears to exist: however, possibly `cfDCContributor` might be used for this purpose	†
Semantic	additional value provided to a collection by a party		

	RIF-CS	CERIF	
Term	isDerivedFrom	No CERIF equivalent appears to exist: however, possibly `cfDCSource` might be used for this purpose	†
Semantic	collection is derived from the related collection, e.g. through analysis		

	RIF-CS	CERIF	
Term	hasDerivedCollection	No CERIF equivalent appears to exist: however, possibly `cfDCRelation` ('A related resource') might be used alongside appropriate qualifiers for this purpose	†
Semantic	the related collection is derived from the collection, e.g. through analysis		

7.3. Party relation type

	RIF-CS	CERIF	
Term	hasAssociationWith	`cfDCRelation` ('A related resource') might be used alongside appropriate qualifiers for this purpose	†
Semantic	has an unspecified relationship with the related registry object		

	RIF-CS	CERIF
Term	hasMember (group only)	`cfPerson_OrganisationUnit`
Semantic	has enroled the related party in the group	

	RIF-CS	CERIF
Term	hasPart (group only)	`cfOrganisationUnit_OrgUnit`
Semantic	contains the related group	

	RIF-CS	CERIF
Term	isCollectorOf	`cfPerson_ResultProduct` or `cfPerson_ResultPublication` (if a 'resultproduct' or 'resultpublication' may consist of a collection) Dublin Core alternative: `cfDCContributor` (may be an editor)
Semantic	has aggregated the related collection	

	RIF-CS	CERIF
Term	isFundedBy	`cfProject_Funding` or `cfPerson_Funding` or `cfOrganisation_Funding` (and so forth)
Semantic	receives monetary or in-kind aid from the related party or program	

	RIF-CS	CERIF
Term	isFunderOf	`cfProject_Funding` or `cfPerson_Funding` or `cfOrganisation_Funding` (and so forth)
Semantic	provides monetary or in-kind aid to the related party or program	NOTE: Where RIF-CS tends to provide two unidirectional links (isFunderOf, isFundedBy), CERIF typically provides only one (which, however, can be used to the same effect)

	RIF-CS	CERIF
Term	isManagedBy	`cfProject_Person` (plus appropriate detailed classification)
Semantic	is overseen by the related party	`cfPerson_OrganisationUnit` may include: 'Affiliation, subaffiliation, head, employer, member, director, deputy director, dean, principle, head of department, group leader, manager, spokesperson, associate, fellow, reviewer, engineer, technician, function' (CiA, 2012)

	RIF-CS	CERIF
Term	isManagerOf	see 'isManagedBy', above
Semantic	oversees the related party or administers the related collection	`cfPerson_OrganisationUnit` may include: 'Affiliation, subaffiliation, head, employer, member, director, deputy director, dean, principle, head of department, group leader, manager, spokesperson, associate, fellow, reviewer, engineer, technician, function' (CiA, 2012)

	RIF-CS	CERIF	
Term	isMemberOf	`cfPerson_OrganisationUnit` (plus appropriate classification)	*
Semantic	is enroled in the related group	`cfPerson_OrganisationUnit` may include: 'Affiliation, subaffiliation, head, employer, member, director, deputy director, dean, principle, head of department, group leader, manager, spokesperson, associate, fellow, reviewer, engineer, technician, function' (CiA, 2012)	

	RIF-CS	CERIF	
Term	isOwnedBy	`cfDCRightsHolder` `cfDCRightsManagement` (Also see `cfDCRightsHolderAccessRights`)	*
Semantic	legally belongs to the related party		

	RIF-CS	CERIF	
Term	isOwnerOf	`cfDCRightsHolder` `cfDCRightsManagement` (Also see `cfDCRightsHolderAccessRights`)	*
Semantic	legally possesses the related activity, collection, service or group		

	RIF-CS	CERIF	
Term	isPartOf	`cfOrganisationalUnit_OrgUnit`	*
Semantic	(group only) Is contained in the related group		

	RIF-CS	CERIF
Term	isParticipantIn	`cfProject_Person` `cfOrganisationalUnit_Person`
Semantic	provides additional value to a collection	

	RIF-CS	CERIF	
Term	enriches	No CERIF equivalent appears to exist: however, possibly `cfDCContributor` might be used for this purpose	†
Semantic	provides additional value to a collection		

8. Candidate mapping: Findings

The Cerif4Datasets project identified two primary candidates for storing metadata around datasets: `cfResultProduct` and `cfDublinCore`. These provide necessary 'descriptive and structural' metadata elements (Garfield et al., 2012), although some required administrative metadata elements are missing.

In our case we also find that `cfDublinCore` can solve many of our problems, at least in principle. However, primarily due to the technical aspects of RIF-CS (i.e. the service discovery elements in particular), and secondly due to the fact that some collection-specific functionality is not explicitly covered, implemented or documented, we have not been able to find candidate mappings for some RIF-CS vocabulary.

CERIF's `cfResultProduct` seems in general to be used as a catch-all for many discipline-specific aims. From the CERIF 1.3 documentation: [13]

> In CERIF, the concept of product is physially (cfResProd) and logically (cfResultProduct) defined as an entity in the ERM, represented by attributes and through maintaining relationships with other entities: classifications, fundings, products, projects, organisations, persons, facilities, equipments, services, media, indicators, measurements.
>
> The entity product in CERIF has often caused confusion, it was maybe not stressed enough, that a CERIF product is considered a result in general, achieved through some effort—and not at all is it a commercial or physical product only. It was intended to also represent i.e. software or 'research data'.

Given that CERIF aims 'to be used for a dataset at a generic level to allow of transfer of data. i.e interoperation' (Mahey, 2012), alongside attendant metadata (creator, dataset production mechanism, etc)—as a dataset production environment, the broad, generic nature of the term is perfectly consistent with CERIF's aims. However, as with most broadly defined/generic terms, this practice gives rise to some attendant ambiguities. It is possible that a mapping that is perfectly acceptable within the published specification may not suit the intent (and consequentially existing implementations) of the standard.

One recommendation, therefore, is to look at the practical implications—both CERIF's usage patterns as it stands, and the assumed semantics encoded by existing interfaces. Our findings indicate that, as it stands, using CERIF to describe either datasets or collections in detail would imply (would certainly be greatly facilitated by) use of the Dublin Core terms available within CERIF. However, it is not clear how widely those terms have been implemented and for which purposes they are intended. Whilst the CERIF standard includes these terms, it is not necessarily the case that a given implementation will make them available, either within the data model or in terms of visual accessibility/manipulability. Since Dublin Core is itself a broad and extensible standard with a plethora of uses, it seems unlikely that an ad hoc use of DC within CERIF will lead to a particularly generic or interoperable result without careful handling (i.e. in effect, the definition and use of an application profile for DC use within CERIF for the purposes of describing a) datasets and b), more broadly speaking, collections).

[13] `http://www.eurocris.org/Uploads/Web%20pages/CERIF-1.3/Physical/TablesB.html`

9. Overall conclusion

It is evident from reviewing available documentation that, although these two standards presently fulfil quite different roles and use cases, there is a convergent stream between them. This is both a problem and an opportunity: a problem, in that the result could easily be the establishment of two relatively complex standards that fill a niche in similar but incompatible ways, and an opportunity, in that it suggests that the two standards can usefully be leveraged in conjunction, if only in the sense that each group could usefully learn from the other. In certain contexts, such as the simple use case in which RIF-CS is known to excel, CERIF does not presently provide opportunity for a mapping to be completed—extensions to CERIF would be required to achieve these purposes within CERIF, whether that extension takes the form of an agreed use of the Dublin Core extensions, creation of additional classification schema, or additional terms/entities/relationships. In others, such as many of the business intelligence and research management use cases touched upon in the literature, it seems likely that CERIF is currently in a better position to fulfil the requirements.

Reviewing current usage patterns of RIF-CS, it appears that it is generally targeted at a specific aim, which could loosely be described as the registration of metadata endpoints in a registry for the purpose of being able to view, index and navigate lists of collections—indexing across sites. When making available an RSS feed, OAI endpoint, or something else containing a collection of data, the resource can be registered in a data registry through provision of a RIF-CS description.

For this specific purpose, CERIF is in effect providing a great deal more functionality and flexibility than is currently required, yet it does not provide some of the specialist/technical vocabulary required for the aim of description of a technical service. Whilst external vocabulary can easily be referenced in CERIF, this would in effect constitute a dialect of CERIF and hence an 'application profile' including externally controlled vocabulary elements.

Developing a candidate mapping from known RIF-CS profiles (i.e. implementations designed to fulfil known use cases) may well be a helpful task, not least because it provides an opportunity to discuss specific functionality identified. An example of this is the extent to which machine-to-machine issues such as service endpoint discovery should be accounted for in CERIF.

The key points, however, are the following:
CERIF performs a series of demanding use cases, key to which are research information management tasks. As commonly applied, RIF-CS performs a more specific 'niche' use case, which is to say, the publication/registration of collection endpoints, alongside administrative metadata and any further information required. A mapping between the two standards is possible and perhaps desirable, but due to the extreme flexibility and breadth of each, it is absolutely vital that any such undertaking proceeds from a known use case/usage profile.

It is recommended that specific use cases are identified. For example, if there are groups using CERIF as part of their research workflow (for example, organisation-wide knowledge management, research information management, etc.) who require publication of research datasets/ research collections (as defined in their field) in an environment in which RIF-CS is used as a standard, then there is a good case for exploring the encapsulation and export of a 'research collection' definition in RIF-CS from a CERIF database. Given the essential ambiguity of CERIF's handling of the 'research product' as a concept, this in itself represents a non-trivial task, likely

to include domain-specific quirks, and a good platform through which to explore some of the potential and limitations of CERIF as a basis for collection management/publication.

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A. Announcing the availability of a collection service with RIF-CS (XML sample)

```
<?xml version="1.0"?>
<registryObjects xmlns="http://ands.org.au/standards/rif-cs/registryObjects"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://ands.org.au/standards/rif-cs/registryObjects
  http://services.ands.org.au/documentation/rifcs/schema/registryObjects.xsd">
  <registryObject group="The Australian Partnership for Sustainable Repositories">
    <key>au.edu.apsr.a1</key>
    <originatingSource>
      http://devl.ands.org.au/deployment/cosi/orca/register_my_data
    </originatingSource>
    <activity type="program">
      <name type="abbreviated">
        <namePart>APSR</namePart>
      </name>
      <name type="primary">
      <namePart>
        The Australian Partnership for Sustainable Repositories
      </namePart>
      </name>
      <location>
        <address>
          <electronic type="url">
            <value>http://www.apsr.edu.au</value>
          </electronic>
        </address>
      </location>
      <relatedObject>
        <key>au.edu.apsr.a2</key>
        <relation type="funds"/>
      </relatedObject>
      <description type="brief">The APSR Project aims to establish a centre of
          excellence for the management of scholarly assets in digital format.
          Online collections of scholarly materials are bringing about a quiet
          revolution in the way researchers work. Researchers have faster easier
          ways of finding and analyzing research materials. New modes of research
          and new research methodologies are all now possible. APSR is a
          partnership that aims to promote excellence in building and managing
          these collections of digital research objects.</description>
    </activity>
  </registryObject>
  <registryObject group="The Australian Partnership for Sustainable Repositories">
    <key>au.edu.apsr.a2</key>
    <originatingSource>http://dspace.anu.edu.au</originatingSource>
    <activity type="project">
      <name type="abbreviated">
        <namePart>ORCA</namePart>
      </name>
      <name type="primary">
        <namePart>Online Research Collections Australia</namePart>
      </name>
      <location>
        <address>
          <electronic type="url">
```

```
            <value>http://services.ands.org.au/home/orca</value>
          </electronic>
          <physical>
            <addressPart type="telephoneNumber">123456789</addressPart>
          </physical>
        </address>
      </location>
      <relatedObject>
        <key>au.edu.apsr.a1</key>
        <relation type="isFundedBy"/>
      </relatedObject>
      <description type="brief">The ORCA Registry project has been established to
          improve the capacity of institutional repositories, archives and data
          centres to create and share collection-level information and resources.
          Its aims are to develop a discovery portal for collections information
          (that is, information about research collections) and a services
          registry that can facilitate machine-to-machine services related to
          managing collections within a network of federated repositories.

        The main priority addressed by the ORCA Registry is to provide a better
          discovery environment for data collections produced by the wide range
          of individuals and institutions involved in the Australian innovation
          system. This includes all Australian higher education institutions;
          Government-funded research organisations (such as CSIRO); and
          commercial and not-for-profit organisations in sectors with research
          interests (such as archives, museums and libraries). It is planned to
          collaborate with similar registry services overseas at a later stage.

        Members of the project reference group are participating in a pilot
          collection registry evaluating the software in a pre-production
          mode.</description>
      <existenceDates>
        <startDate dateFormat="W3CDTF">2007-06-01T00:00:00Z</startDate>
      </existenceDates>
      <relatedInfo type="website">
        <identifier type="uri">
          http://services.ands.org.au/home/orca/rda/index.php
        </identifier>
      </relatedInfo>
    </activity>
  </registryObject>
  <registryObject group="TheAustralian National University">
    <key>au.edu.anu.dspace.1885/42756</key>
    <originatingSource>http://dspace.anu.edu.au</originatingSource>
    <collection type="collection">
      <identifier type="handle">hdl:1885/42756</identifier>
      <name type="primary">
        <namePart>Aboriginal Population Profiles for Development Planning in the
            Northern East Kimberley</namePart>
      </name>
      <location>
        <address>
          <electronic type="url">
            <value>http://dspace.anu.edu.au/handle/1885/42756</value>
          </electronic>
        </address>
      </location>
      <relatedObject>
```

```
        <key>au.edu.anu.dspace.RSS1.0</key>
        <relation type="supports">
          <url>http://dspace.anu.edu.au/feed/rss_1.0/1885/42756</url>
        </relation>
      </relatedObject>
      <relatedObject>
        <key>au.edu.anu.dspace.RSS2.0</key>
        <relation type="supports">
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        </relation>
      </relatedObject>
      <relatedObject>
        <key>au.edu.anu.dspace.browse</key>
        <relation type="supports">
          <url>http://dspace.anu.edu.au/handle/1885/42756/browse-title</url>
        </relation>
      </relatedObject>
      <relatedObject>
        <key>au.edu.anu.dspace.e83</key>
        <relation type="isManagedBy"> </relation>
      </relatedObject>
    </collection>
  </registryObject>
  <registryObject group="The Australian National University">
    <key>au.edu.anu.dspace.e1</key>
    <originatingSource>http://dspace.anu.edu.au</originatingSource>
    <party type="person">
      <name type="primary">
        <namePart type="family">Yeadon</namePart>
        <namePart type="given">Scott</namePart>
      </name>
      <relatedObject>
        <key>au.edu.anu.dspace.1885/43286</key>
        <relation type="isManagerOf"> </relation>
      </relatedObject>
      <relatedObject>
        <key>au.edu.anu.dspace.1885/43285</key>
        <relation type="isManagerOf"> </relation>
      </relatedObject>
      <relatedObject>
        <key>au.edu.anu.dspace.1885/43288</key>
        <relation type="isManagerOf"> </relation>
      </relatedObject>
      <existenceDates>
        <startDate dateFormat="W3CDTF">1954-06-01T00:00:00Z</startDate>
        <endDate dateFormat="W3CDTF">2007-05-01T00:00:00Z</endDate>
      </existenceDates>
    </party>
  </registryObject>
</registryObjects>
```

Source: http://services.ands.org.au/documentation/rifcs/example/rif.xml