

FDO Forum FDO Requirement Specifications Version 2.1

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Current and previous versions:

FDO Requirement Specification PR2.0: [PR-RequirementSpec-2.1-20221017](#)

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FDO Requirement Specification PR2.0: [PR-RequirementSpec-2.0-20220826](#)

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Abstract

This FDO Requirement Specification document specifies the criteria which digital entities need to fulfill to be accepted as FAIR Digital Objects. These specifications need to be adhered to by all implementations that claim to be FDO compliant. The requirements are written at a level that allows for different implementations. The specifications are split into generic guidelines to characterize the landscape in which FDOs will exist and more specific requirements.

Status of this document

This FDO Requirement Specification Proposed Recommendation PR 2.1 is based on the previous PR2.0 document which did not have any further comments. Originally, the FDO Requirement Specification document was based on the version called FDO Framework V1.02 Requirements, which was released after the Paris meeting [1], and the many discussions which

took place in the FDO Forum during the writing of the other FDO specification documents. While FDO F V1.02 emerged outside of the FDO Forum process, all follow-up versions were being released in accordance with the official FDO Forum document process guidelines.

This FDO Requirements Specification might be amended with implementation guidelines for compliant technology stacks, such as Digital Object Architecture and Linked Data. While these implementation examples are not part of these specifications, they can be used for illustration purposes.

Acknowledgements

We would like to thank the Paris meeting participants for their initial contributions to the first external version which was edited by Luiz Bonino and Peter Wittenburg, the many contributions made by all FDO Working group members to come to the version open for comments to the whole FDO community.

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1. Generic Guidelines

These generic guidelines are meant to describe the landscape in which FDOs can exist independent of any specific compliance requirements.

G1: FDOs should provide a path for long term infrastructure investments that is not tied to any particular technology stack.

G2: FDOs need to generate trust in accurate data survival over long periods of time, assuring researchers, funders, and developers that their significant effort in reusing them will be worthwhile.

G3: FDOs must offer compliance with the FAIR principles through measurable indicators of FAIRness.

Note: The FDO Forum will not become engaged in measuring FAIRness. Initiatives organised in the framework of RDA (<https://www.rd-alliance.org/groups/fair-data-maturity-model-wg>) or CODATA (<https://codata.org/worldfair-global-cooperation-on-fair-data-policy-and-practice-a-major-two-year-project-starts-today/>) are working on this topic.

G4: FDOs need to support machine actionability as being specified by FDO PR-MachineActionDef-2.0 [2] or later.

G5: FDOs need to support the abstraction principle, i.e., abstracting away details that are not needed at the basic object management level. At that level there is no need to distinguish among different types such as data, metadata, software, semantic assertions, etc., for data management operations.

G6: FDOs need to support stable bindings among all information entities required for machine navigation of the global data space through the use of global, unique, and resolvable persistent identifiers.

G7: FDOs need to support encapsulation, such that operations can be associated with FDOs of all types.

Note: A typing system for FDOs is currently being worked out by FDO Forum [3].

G8: FDOs need to support technology independence, allowing implementations using different technologies.

G9: FDOs need to comply with minimal agreed standards, e.g., for movement of FDOs between systems, for interaction with FDOs, etc., to guarantee FDO interoperability across heterogeneous systems.

Note: G9 needs to be amended when specific implementations have been made available as basis for FDOs and when additional standardization processes have been accomplished.

2. FDO Requirements

These requirements specify the rules that must be met by all implementations claiming FDO compliance. These requirements may evolve due to the increasing insights obtained from implementation experience.

FDOR1: A *PID*, standing for a globally unique, persistent and resolvable identifier, is assumed to be the basis for FAIR Digital Objects. Every FDO is assigned one or more PIDs.

FDOR2: A PID resolves to a structured record (*PID Record*) compliant with a specified *PID Profile* which leads to resolution results that enable programmatic resolution from PID back to the FDO and its elements as specified by these requirements. PID Records represent the information characterizing FDOs and together with their resolving PIDs they can be themselves FDOs.

Note: The term "PID Record" has been used extensively for historical reasons, however, the term "FDO Record" would be more appropriate since it contains attributes describing FDO properties.

Note: The FDO Typing System is currently being specified. PID Profiles will be specified by communities of practices.

FDOR3: If an FDO contains a structured bit-sequence, the structured PID record includes at least a reference to the location(s) where the bit-sequence encoding the content of a FAIR-DO (FDO) can be accessed and the type definition of the FDO. The structured record may also contain PIDs pointing to *Metadata FDOs* describing properties of the target FDO.

FDOR4 The PID record needs to contain mandatory FDO attributes, may contain optional FDO attributes and attributes agreed upon by recognized communities. Values of attributes can be references. Expectations of such references should be specified in the PID profile or definition of said attribute in a Data Type Registry.

Note: Values of attributes can be presented as RDF assertions or as "attribute-value pairs" allowing machines to act.

Note: Data Type Registry entries are identified by a PID and should be FAIR compliant.

Note: It was discussed whether there should be just two categories (mandatory, optional), but it was agreed that (a) the set of mandatory attributes will be small given also different FDO configuration types, (b) the FDO Forum needs to define attributes which are widely used to increase interoperability and (c) the communities definitively will have the freedom to add attributes which are important for their needs.

FDOR5: Each FDO identified by a PID can be accessed or operated on using an interface protocol by specifying the PID of a registered supported operation.

Note: In general the protocol in the Internet is identified by a protocol specification such as "http, ftp" etc.

FDOR6: Any basic FDO interface protocol offers standard Create, Read, Update, Delete (CRUD) operations on FDOs and a possibility to use extended/domain operations for specific applications.

FDOR7: The relations between FDO Types and supported operations are maintained in separate registries.

FDOR8: Metadata can themselves be FDOs which describe the properties of the referenced FDO. They must be specified by a registered schema that refers to defined and registered metadata categories.

Note: The FAIR principle F1 requires (meta)data to be assigned a persistent identifier. Implementations need to indicate how this can be satisfied.

FDOR9: Metadata can be of different types such as descriptive, deep scientific, provenance, system, access permissions, transactions, etc.

Note: Currently, these different types are dealt with by different mechanisms. A unification is required to enable machine actionability.

FDOR10: Metadata schemas are maintained by communities of practice and are FDOs. Such metadata schemas should therefore themselves follow FAIR principles

FDOR11: A collection of FDOs is also an FDO. The content of collection FDOs describes its construction using an agreed formal language which specifies the relationships of the constituent members. An FDO may be a member of several collections.

Note: In the body of a collection FDO there should be statements such as “xyz is_part_of uvw” if “uvw” is the target collection and “xyz” is one of its constituents.

FDOR12: Deletion of an FDO must lead to standardised and thus machine interpretable tombstone notes in metadata and PID records. The PID itself is not deleted.

3. References

[1] FDO Framework V1.02:

<https://github.com/GEDE-RDA-Europe/GEDE/blob/master/FAIR%20Digital%20Objects/FDOF/FAIR%20Digital%20Object%20Framework-v1-02.docx>

[2] FDO Machine Actionability: [PR-MachineActionDef-2.0-20220611](#)

[3] Typing Document Ref. to come [WD-TypingFDOs-1.0-20220310](#)

4. Changes from previous versions

This version WD0.3 has the status of a WD to be discussed in the TSIG WG and then in the FDO Forum.

Version	Who	Date	Comment
FDO F V0.2	Paris Meeting recommendation	December 2019	This document was endorsed by the participants of the Paris Meeting after editing by L. Bonino and P. Wittenburg
WD0.3	FDO R Editors	February 2022	since the version FDO F V1.02 was broadly discussed in the FDO TSIG WG we assign it the version number 0.3, many changes have

			been applied to this version which we will not document in detail, we needed to remove the term “framework” since this term is now used by L. Bonino for his website and FDO Forum needed to urgently overcome huge confusions
WD1.0	FDOR Editors	March 2022	For FDOR3 a further note was added to indicate the necessity of three attribute categories: FDO mandatory, FDO optional, Community specified. - also the empty chapter 4 “Errata” was removed since we will use Google docs to document discussions.
PR2.0	FDOR Editors & Authors	August 2022	<ul style="list-style-type: none"> - The editors, G. Strawn and P. Wittenburg, suggested to include all major commenters as authors of this document which they accepted - Improvement of the G1 Formulation - Update of the reference in G4 - Reformulation of FDOR2 and adding a note to capture the comments made, introducing the synonym “FDO Profile” - change of the order in FDO3 and FDO4 including renaming them - Reformulation of the new FDOR3 to capture the comments made - Reformulation of the new FDO4 to capture the comments made - Improvement of the formulation of FDOR5 and FDOR7 to include "supported" - Improvement of the FDOR8 formulation - Extension of the FDOR11 formulation to capture the comments. - Improvement of the FDOR12 formulation
PR2.1	Editors	17.10.2022	- no further comments were made