

IFC-Bank of Italy Workshop on "Data science in central banking: enhancing the access to and sharing of data"

17-19 October 2023

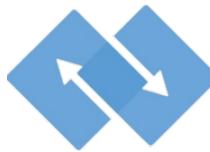
Collaborating on SDMX APIs and open-source software¹

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¹ This contribution was prepared for the workshop. The views expressed are those of the authors and do not necessarily reflect the views of the Bank of Italy, the BIS, the IFC or the other central banks and institutions represented at the event.

A large, modern building with a curved facade and a pattern of light-colored panels and dark windows. The building is set against a clear blue sky. The image is tilted at an angle, creating a dynamic feel.

Collaborating on SDMX APIs and Open
Source Software



SDMX – the ISO Standard

- **Effective governance**
 - Eight international organizations (sponsors)
- **Continuously evolving**
 - SDMX 3.0 (latest release) – Improved support for micro/big/geo data
- **Collaborative evolution**
 - working groups & task forces, involving national and international organisations (and independent consultants)
 - [SDMX 2025 roadmap](#)
- **Comprised of a robust Information model + technical standard for modelling any data & implementing tools.**
- **SDMX in G20 DGI work ([Data Gaps Initiative](#))**
 - International Data Cooperation / Data Sharing & Access
 - Data Structure Definitions (DSDs) established for several domains





SDMX – The Vision

● Improve Quality

- **Standardize and harmonize Data and Metadata exchange** through agreed formats, ensuring consistency and comparability
- **Robust information model** supporting the entire data lifecycle
- Foster Collaboration

● Promote Efficiency

- Enhance Data Sharing, ie **support production, exchange and dissemination of statistics** for public good
- Enable automated (machine to machine) data sharing and process automation

● Drive Innovation

● Facilitate Data Use

- Web services
- Connectors (Python, R, MS Power BI, ...)



Web Services – the SDMX v2 API

- A RESTful API maintained by SDMX-TWG Task Force 4
 - 9 releases since 2011 (first released with SDMX 2.1)
- The 9th release (with SDMX 3.0 – Sep 2021) features:
 - Enhanced data queries and reference metadata support
 - Restructured resources (breaks backwards compatibility to v1.*)
 - Metadata maintenance (additional HTTP verbs – POST, PUT, DELETE)
 - Schema query “allowed content” in more formats
- Improved clarity and documentation of the API
- Deprecated SOAP API



The structure queries

- Re-organized and enriched
- Supports multiple instances of search terms, wildcarding

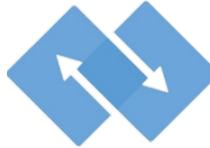
The unique identifier:
 - Agency ID
 - Artefact ID
 - Version
 - Item ID (for Item Schemes)

`https://host/structure/type/agency/id/version/item?detail&references`

The type of structure:
 datastructure, metadatastructure, categoriescheme,
 conceptscheme, codelist, hierarchy, hierarchyassociation,
 valuelist, agencyscheme, dataprovderscheme,
 dataconsumerscheme, organisationunitscheme, dataflow,
 metadataflow, reportingtaxonomy, provisionagreement,
 structuremap, representationmap, conceptschememap,
 categorieschememap, organisationschememap, reportingtaxonomymap,
 process, categorisation, dataconstraint, metadataconstraint,
 structure, transformationscheme, rulesetscheme,
 userdefinedoperatorscheme, customtypescheme,
 namepersonalisationscheme, vtlmappingscheme

Amount of information:
 allstubs, referencestubs,
 allcompletstubs,
 referencecompletstubs,
 referencepartial, raw,
 partialraw, full

References to be returned:
 none, parents,
 parentsandsiblings,
 ancestors, children,
 descendants, all,
 a resource type



The data queries

`https://host/data/context/agency/id/version/key?c`

The context of data retrieval:
datastructure, dataflow,
provisionagreement

Key(s) of the series to be returned:
eg M.GR.EUR.SP00

with wildcarding:
eg M.*.EUR.SP00

With support for multiple keys:
eg M.GR.EUR.SP00, M.CY.EUR.SP00

Component-based filters (for any Dimension, Attribute or
Measure):

eg `c[REF_AREA]=CH&c[CONF_STATUS]=F`

Support for operators:

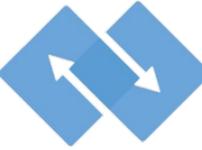
eg `c[ICP_ITEM]=sw:01&c[TIME_PERIOD]=ge:2015`

The unique identifier of the context:

- Agency ID
- Artefact ID
- Version

&updatedAfter
&firstNObservations
&lastNObservations
&attributes
&measures
&dimensionAtObservation
&includeHistory

eq	Equal
ne	Not equal
lt	Less than
le	Less than or equal to
gt	Greater than
ge	Greater than or equal to
co	Contains
nc	Does not contain
sw	Starts with
ew	Ends with
nd	And
or	Or



The data queries

`https://host/data/context/agency/id/version/key?c`

Retrieves what changed since supplied timestamp. Must be percent-encoded (e.g.: 2009-05-15T14%3A15%3A00%2B01%3A00)

Maximum number of observations starting from the first observation

Maximum number of observations counting back from the most recent observation

Id of the dimension at the observation level

The attributes to be returned:
dsd, msd, dataset, series, obs, all, none, {attribute_id}

The measures to be returned:
all, none, {measure_id}

Whether to return vintages

&updatedAfter
&firstNObservations
&lastNObservations
&attributes
&measures
&dimensionAtObservation
&includeHistory



Other queries

- Data validity

`https://host/schema/context/agency/id/version?dimensionAtObservation
&explicitMeasure`

- Data availability

`https://host/availability/context/agency/id/version/key/componentId?c
&updatedAfter
&references
&mode`

- Metadata

`https://host/metadata/metadataSet/provider/id/version?detail`

`https://host/metadata/metadataFlow/agency/id/version/provider?detail`

`https://host/metadata/structure/type/agency/id/version/provider?detail`



SDMX 3.0 RESTful API v2.0.0

- The normative part of the specification, i.e. the [Open API definition](#)
- The [Developers' documentation](#), including a [cheat sheet](#)
- Request features and report issues on [GitHub](#)
- See the API spec on [SwaggerHub](#)
- The SDMX v2 API in [action](#)

The image shows two screenshots of the SDMX 3.0 RESTful API v2.0.0 documentation.

GitHub Repository: <https://github.com/sdmx-twg/sdmx-rest>

The GitHub repository interface shows the following details:

- Code:** 806 lines (779 loc) - 27.1 kB
- Issues:** 20
- Pull requests:** 1
- Discussions:** 0
- Actions:** 0
- Projects:** 0
- Security:** 0
- Insights:** 0

SDMX 3.0 RESTful web services cheat sheet, v2.0.0

The cheat sheet contains the following text:

```

1 openapi: 3.0.0
2 info:
3   version: '2.0.0'
4   title: 'SDMX RESTful API, v2.0.0'
5   description: |
6     the RESTful API for SDMX 3.0.
7
8 For additional information, check the [documentation](https://github.com/sdmx-twg/sdmx-rest/tree/develop/v2_1/ws/rest/docs).
9 servers:
10  - description: Mock implementation (just for demo purposes!)
11    url: https://localhost/
12
13  x-commons:
14    common_responses: &common_responses
15    '304':
16      $ref: '#/components/responses/304'
17    '400':
18      $ref: '#/components/responses/400'
19    '401':
20      $ref: '#/components/responses/401'
21    '403':
22      $ref: '#/components/responses/403'
23    '404':
24      $ref: '#/components/responses/404'
25    '406':
26      $ref: '#/components/responses/406'
27    '415':
28      $ref: '#/components/responses/415'
  
```

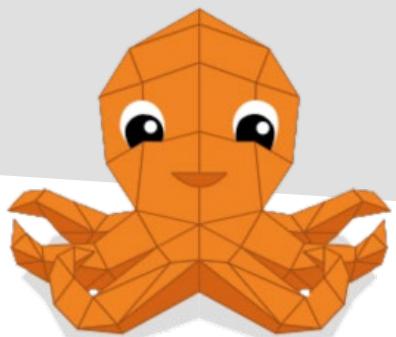
SwaggerHub: <https://app.swaggerhub.com/apis/sdmx-twg/sdmx-rest/v2.0.0>

The SwaggerHub interface shows the API structure with the following sections:

- Info:** Version 2.0.0
- Tags:** None
- Servers:** None
- Search:** None
- Data queries:**
 - GET /data/{context}/{agencyID}/{resourceID}/{version}/{key}
 - GET /availability/{context}/{agencyID}/{resourceID}/{version}/{key}/{componentID}
 - GET /schema/{context}/{agencyID}/{resourceID}/{version}
- Structure queries:**
 - GET /structure/{structureType}/{agencyID}/{resourceID}/{version}
 - GET /structure/{itemSchemeType}/{agencyID}/{resourceID}/{version}/{itemID}
- Reference metadata queries:**
 - GET /metadata/structure/{structureType}/{agencyID}/{resourceID}/{version}



sdmx.io





What is sdmx.io?

sdmx.io is not a single project but an **ecosystem of open source tools, patterns, guidance, learning materials and other resources** like pre-configured containerised environments that make the software quick and simple to deploy.

- An **open-source SDMX software and resource portal**
 - Software releases (FMR, FusionXL, etc.)
 - E-learning courses and webinars
 - Knowledge and use-case articles
- **Governance in place, incl. Prioritisation and User Advisory Groups**
- **Officially public**, after the SDMX Sponsors approval

- Share software tools and components based on SDMX
- Complement existing tools in order to achieve statistical use-cases
- Interface SDMX with other standards or tools
- Promote reusability of SDMX software



Collaboration partners and activities

- **IMF:** IMF SDMX Central is powered by FMR11 (since Sep 2023)
- **SIS-CC/Eurostat/BIS:** working closely on achieving SDMX 3.0 compliance
- **OECD/SIS-CC:** .Stat/FMR integration for the National Bank of Belgium (**NBB**) use case
 - FMR Workbench
 - .Stat Suite on sdmx.io
- **NBB:** Launch of FMR Workbench user group (targeting CBs and SIS-CC members)
- **Eurostat:** SDMX Reference Implementation for SDMX 3.0
 - sdmx-core evolution (Java/.Net)
- **Banca d'Italia:** VTL Engine & FMR → exploring the use cases
 - UNSD working with Bdl on the first use case
- **Meaningful Data:** SDMXthon & FMR → exploring the use cases



The use-cases



Statistics production



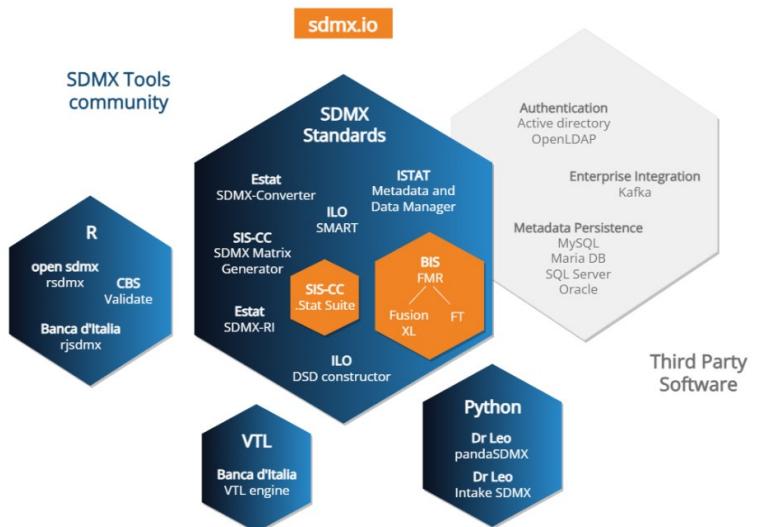
Statistics dissemination



Data domain modeling



Data collection



eLearning Catalogue

sdmx.io's library of learning resources covers a diverse range of topics including how to use software tools, SDMX theory and data modelling best practice.

FMR on GitHub

GitHub interface showing the Fusion Metadata Registry (FMR) repository. The repository has 233 cards across various stages of development.

Overview: The repository has 233 cards, 42 in the Wish list, 80 in To do, 8 In progress, 7 Unreleased, and 233 Done. The repository is private and has 174 issues and 10 pull requests. It is updated yesterday.

Wish list (42 cards):

- Exporting artefacts to formats not suitable for artefacts of that type (fmr#121)
- Cannot update a DSD used by a dataflow referenced in a StructureMap (fmr#108)
- Advanced mapping/reading features (fmr#101)
- Prevent defining identical mappings in the same RepresentationMap (fmr#104)
- Measure array support (fmr#87)
- Remove Spring from fusion-core (fmr#59)
- UI - new links field (fmr#40)
- Geographic Codelists - syntax validation of GeoFeatureSet expressions (fmr#43)

To do (80 cards):

- Change the way large numbers of validation errors are handled to reduce memory pressure (fmr#238)
- Amend representation map documentation with additional examples (fmr#176)
- Investigate issue with mapping in FMR10 (fmr#493)
- Issue with response from dataflow query (MEDAL-related) (fmr#369)
- Statistics Netherlands FMR pen test results - response needed to the user (fmr#486)
- SDMX-JSON 3.0 data format (excluding hierarchical reference metadata) (fmr#50)
- EU login / authentication support (fmr#380)

In progress (8 cards):

- SDMX-ML (XML) 3.0 data format (excluding hierarchical reference metadata) (fmr#53)
- Mapping produces invalid output (fmr#544)
- Mapping issues (fmr#518)
- Agree and document FMR structure mapping behaviour (fmr#421)
- Metadata time travel (fmr#9)
- SDMX Central - FMR Fusion Excel data format writer MVP (fmr#510)
- Problem with loading XLSX in 'Browse Registry' (fmr#380)

Unreleased (7 cards):

- Structure - Metadata Constraint SDMX-JSON v2 (fmr#31)
- Report error if publication table is queried for in sdmx-json format (fmr#540)
- Using V2 Sdmx API, "saveAs" and Zip format creates empty output (fmr#537)
- Querying for StructureSet returns unhelpful error message (fmr#539)
- Restore Fusion Security as Authentication Service Option (fmr#533)
- Reference metadata in fusion-json (fmr#509)
- SDMX-JSON 2.0.0: Problem with structure of messages containing hierarchies (fmr#507)

Done (233 cards):

- Integration testing improvements (including incorporating format conversion, structure mapping, structure validation test suites) (fmr#241)
- SDMX-JSON 2.0.0: Wrong output for cube regions (fmr#504)
- FMR API Performance (fmr#492)
- Constraints causing NullPointerException in FMR 11.10.0 (fmr#538)
- Publish updates to metadata reports to a Kafka topic (fmr#442)
- Add new format option to Kafka producer (fmr#451)
- Add meta header to Fusion-JSON to (fmr#380)

Bottom right: Java 28.5% progress bar.



Thank you!

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