

Factsheet – Step 6 Application Programming Interfaces (APIs)

What are APIs?

APIs offer a structured and standardized approach to data exchange, making them inherently compatible with the FAIR principles and ensuring data-sharing processes are FAIR. One key reason that project sponsors or data consumers would opt for APIs over other mechanisms is the inherent alignment of APIs with the FAIR Principles, particularly in terms of interoperability and accessibility. These APIs enable farmers, researchers, and agricultural stakeholders to access and leverage various data sources and services.

Key aspects of APIs

1. **Methods and functions:** APIs provide a set of methods or functions that developers can invoke to perform specific tasks or access certain functionalities of a software system.
2. **Data formats:** APIs specify the data formats used for communication between applications. Common formats include JSON (JavaScript Object Notation) and XML (eXtensible Markup Language).
3. **Endpoints:** APIs define endpoints, which are specific URLs (Uniform Resource Locators) or URIs (Uniform Resource Identifiers) where API requests can be made. Each endpoint corresponds to a particular function or resource within the system.
4. **Authentication and authorization:** APIs often include mechanisms for authentication and authorization to control access to their functionalities. This ensures that only authorized users or applications can interact with the API.
5. **Request and response:** Communication between applications through an API typically involves making requests and receiving responses. Requests contain information about the operation to be performed, and responses include the results or data returned by the API.

6. **RESTful APIs:** Representational State Transfer (REST) is a common architectural style for designing networked applications. APIs that adhere to REST principles are called RESTful APIs. They use standard HTTP methods (GET, POST, PUT, DELETE) for communication.
7. **SOAP APIs:** Simple Object Access Protocol (SOAP) is a protocol for exchanging structured information in web services. SOAP APIs use XML for message formatting and often rely on HTTP or SMTP for transport.

Advantages of APIs

1. **Standardized access and interoperability:** APIs provide a standardized interface for accessing data and services, simplifying the process of retrieving information and eliminating the need for complex data retrieval mechanisms. This standardization enhances interoperability and accessibility, which are key components of the FAIR principles.
2. **Flexibility and scalability:** APIs offer a level of flexibility and scalability essential for meeting FAIR data sharing requirements. They can be designed to support various data formats and structures, allowing for the integration of heterogeneous data sources and promoting data interoperability.
3. **Real-Time data exchange:** APIs facilitate real-time data exchange, which is crucial for ensuring the timeliness and relevance of shared data. This capability supports the FAIR principle of providing data as soon as it becomes available.
4. **Enhanced reusability:** By offering a standardized interface for accessing and manipulating data, APIs enable data consumers to easily integrate shared data into their workflows and applications, promoting data reuse and maximizing the value of shared information.
5. **Innovation and collaboration:** APIs serve as bridges connecting different systems, fostering a collaborative ecosystem where data can be shared, automated and redistributed efficiently. This interconnectedness facilitates the development of new services and applications by leveraging existing data and functionalities.
6. **Business opportunities:** APIs support the creation of new business models and revenue streams through the monetization of services and data, unlocking additional value for organizations and stakeholders, and can serve as a business development for organizations setting standards in the ecosystem.

7. **Data security and compliance:** APIs contribute to enhancing data security and compliance for data consumers. By providing controlled access to data sources based on predefined settings, APIs ensure that data sharing adheres to established privacy and security protocols.

APIs Compared to other Data Sharing Mechanisms

Data Sharing Mechanism	Description	Alignment with FAIR Principles	Reusability	Developer Experience /Technical Know-how	Cost	Performance	Security
API	Flexible, real-time, secure, reusable and developer-friendly. Offers granular control over data access, supports various data formats, and enables integration with diverse systems.	APIs are highly aligned with FAIR principles, offering strong support for findability, accessibility, interoperability, and reusability.	High	High	Varies/depends on chosen API (e.g., open-source APIs, or commercially available APIs)	High	High
Extract, Transform, Load (ETL)	Batch-oriented, for large data volumes and complex transformations.	ETL can align with FAIR but requires effort.	High	Moderate	\$99 and \$2,000+ per month for the most popular ETL solutions.	Moderate	Moderate
File transfer	Used for simple, small, static datasets.	Poorly aligned with FAIR principles.	Low	High	\$5.00 to \$12 per month	Low	Low
Remote Procedure Call (RPC)	High performance for tightly coupled systems.	RPC is generally poorly aligned with FAIR principles. It often lacks mechanisms for discoverability, accessibility control, and interoperability.	Low	Moderate	Pricing varies, averaging \$10 per month	High	Moderate
Event-based/brokered messaging	Decouples systems, handles high volumes.	Can be aligned to FAIR principles, requires design/coding (efforts) of application to align with FAIR.	Moderate	Moderate	Pricing varies	Moderate	High
Data streaming	Real-time analytics, Low latency	Data streaming can be well aligned with FAIR principles when implemented with a focus on metadata, schema standardization, and security.	Low	Moderate	Pricing varies \$1.68 per day, or \$52.14 per month. Depends on the service provider.	High	Moderate

In conclusion, the alignment of APIs with the FAIR Principles makes them a preferred choice when seeking to establish efficient, interoperable, and reusable data-sharing practices. By leveraging APIs, projects/programmes can ensure that their data-sharing processes adhere to the FAIR Principles, thereby enhancing the overall quality and usability of shared data.

Examples of APIs

The following examples demonstrate how APIs in agriculture cover a wide range of functionalities, from weather data and precision farming to market information and soil analysis. Integrating these APIs into various agricultural applications and platforms enhances the efficiency and effectiveness of farming practices and decision-making. For the most accurate and up-to-date pricing information, it is advised to contact these organizations directly.

APIs	Description
Agriculture	
John Deere Operations Center	Enables integration with John Deere's precision farming platform, allowing farmers to access and manage data related to equipment, field operations and agronomic practices.
NRCS Web Soil Survey	Allows users to access soil survey information from the Natural Resources Conservation Service (NRCS), providing detailed soil data for agricultural planning and management.
Food and Agriculture Organisation (FAO)	Provides access to a variety of agricultural data, including crop production statistics, trade data, and information on food security.
Tropicos	Provided by the Missouri Botanical Garden, Tropicos API offers access to a plant database, including information on plant taxonomy, distribution, and characteristics.
AGCO	AGCO, a manufacturer of agricultural equipment, offers APIs that allow integration with their machinery, providing farmers with insights into equipment performance and maintenance.
Weather	
OpenWeatherMap	Provides access to weather data, including current conditions, forecasts, and historical weather information. Farmers can use this data for better decision-making in crop management.

APIs	Description
Satellite imagery	
NASA Earth Observing System Data and Information System (EOSDIS)	Provides access to a variety of satellite imagery and remote sensing data that can be used for monitoring crop health, land use, and environmental conditions.
Market Data	
USDA Market News	Offers access to market data, including commodity prices, supply and demand information, and market trends. This data is valuable for farmers and traders in making informed decisions.
Generic	
CKAN	Robust, FAIR-compliant, web interface, open-source.
Dataverse	Research data focus, versioning, provenance, open-source.
GeoNode	Geospatial data, metadata standards, open-source.
DataHub	Collaboration, governance, data lineage.
OpenRefine	Data cleaning, transformation, interoperability. Open-source.
AWS Data Catalog	Centralised metadata, AWS services (subscription available).
Google Cloud Data Catalog	Metadata repository, Google Cloud Platform (subscription available).

Other expenses could include the use of hosting services and cloud storage services for hosting data assets. Pricing varies depending on which service is chosen – here are some example comparisons: <https://www.whatsthehost.com/>.



MaDiPHS Data Catalogue (built on CKAN API)



CABI Data Repository (built on CKAN API)