

Strengthening satellite data exchange with WIS2

CGMS

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WORLD
METEOROLOGICAL
ORGANIZATION

STEP 1 : THE FOUNDATION

Evolution of WMO data exchange

1963 World Weather Watch

1970s Global Telecommunication System (GTS)

2007 WMO Information System (WIS)

2019 WMO Reform (Earth System Approach)

2021 WMO Unified Data Policy (Core, Recommended)



WIS 2.0

... collaborative system of systems using Web-architecture and open standards to provide simple, timely and seamless sharing of trusted data and information ...

- Open Standards (OGC, W3C, IETF, ...)
- Free and Open Source tooling
- Data sharing through Web and real-time notifications with publication/subscription (pub/sub) protocols
- Cloud ready (turn-key solutions)
- Web services and APIs (Application Programming Interface)

Resolution 34 (EC-76)

Implementation plan update of the WMO Information System 2.0

[\[WMO-No. 1314, pg. 1147\]](#)

Resolution 25 (Cg-19)

Technical Regulations of the WMO Information System 2.0

[\[WMO-No. 1326, pg. 209\]](#)



WIS2 Context

WIS2.0 Technical Foundations

Message Queuing
Protocols

OGC Metadata
Standard

Provide
expandable
services-
architecture

Unified monitoring
approach

Functional Requirements

Using open
standards

Using Web
solutions

Cloud ready
solutions

Support
Big Data

Business Requirements

Emerging
Data Issues





Support
GBON

Support
Unified
Data Policy

Support All
WMO
Programmes

Replace GTS

WIS2 Components: WIS2 Nodes

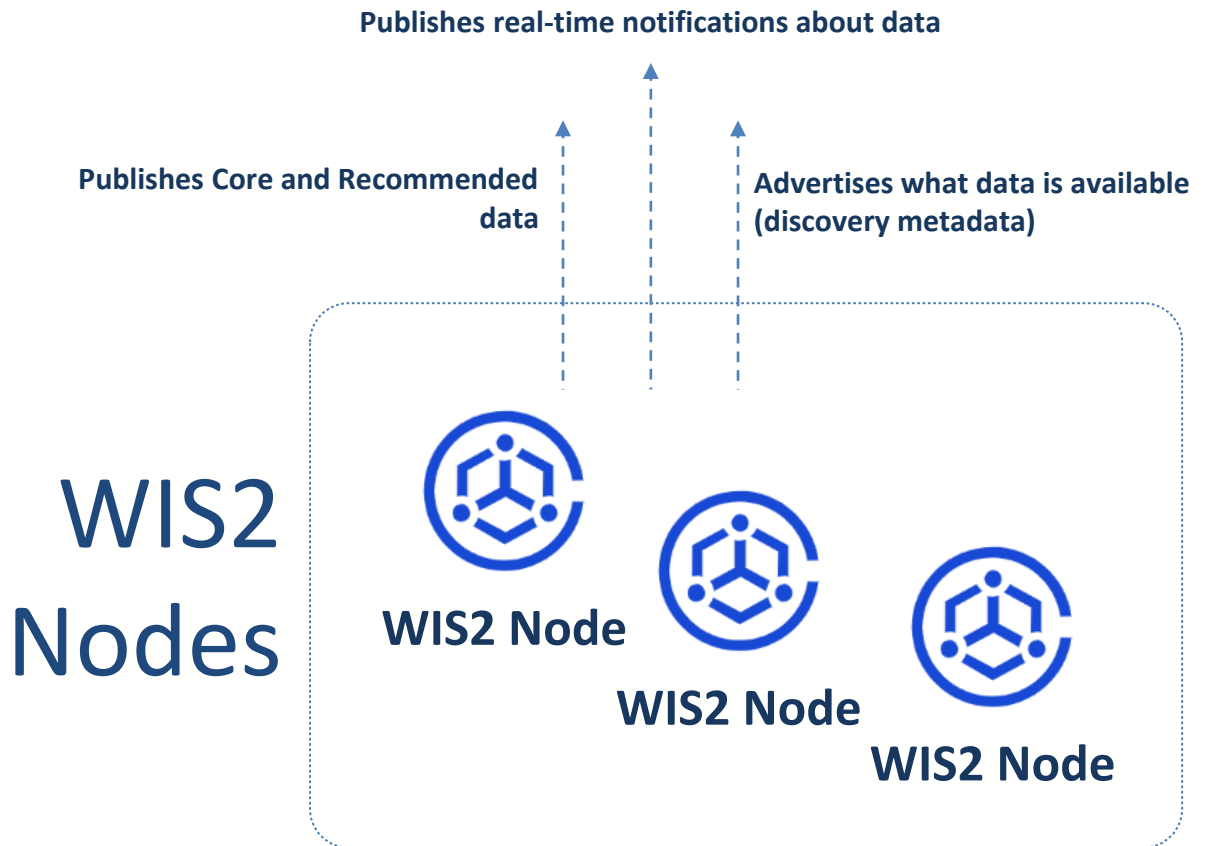
-  Each WMO Member shall implement at least one WIS2 Node to share data in WIS2
-  A WIS2 Node replaces the GTS Message Switching System
-  Data and metadata are shared using a WIS2 Node
-  A WIS2 Node shares data via an HTTPS service and sends notifications to MQTT subscribers



WMO OMM



Data users



WIS2 Components: Global Services



Global Services



Global Monitoring

Discovers datasets

Subscribes to topics

Downloads core data

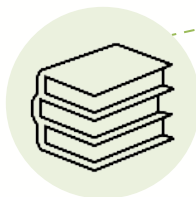
Downloads recommended data

Downloads recommended data

Downloads recommended data

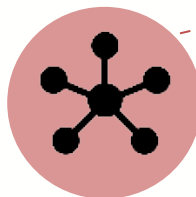


Data users



Global Discovery Catalogue

Provides an API to discover datasets and services



Global Broker

Sends notifications of new data to be downloaded from Global Caches or WIS2 nodes



Global Cache

Provides users HTTP download of core data cached from WIS2 nodes



WIS2 node



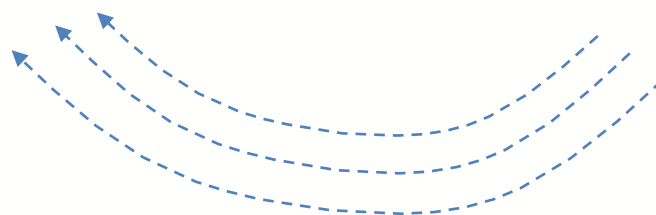
WIS2 node



WIS2 node

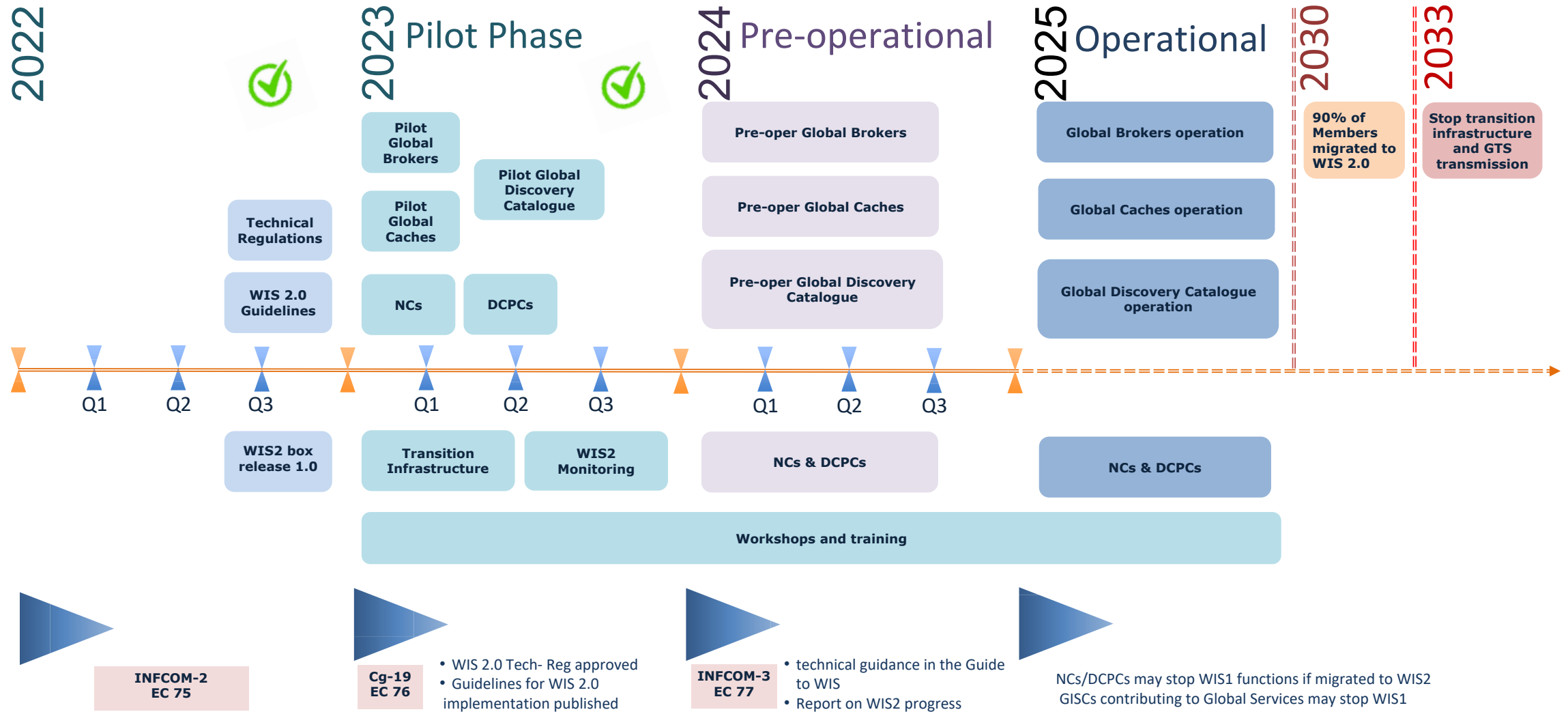


WMO OMM



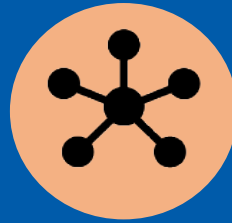
Scale to highly-available, global data sharing

WIS2 progress: Pilot Phase complete



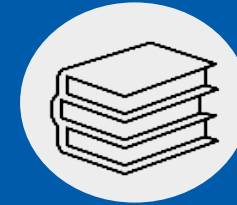
WIS2 Global Service instances

**Global
Broker**



**Brazil
France
China
USA**

**Global
Discovery
Catalogue**



**Canada
China
Korea**

**Global
Cache**



**China
Germany
Japan
Korea
USA/UK**

**Global
Monitoring**



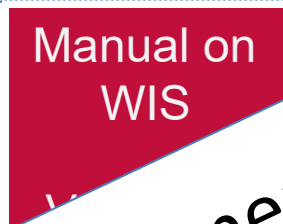
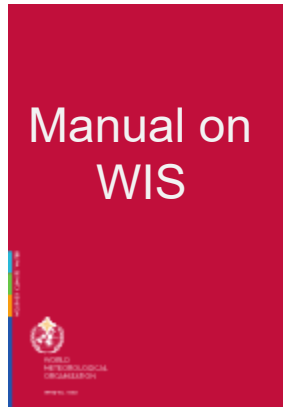
**China
Morocco**



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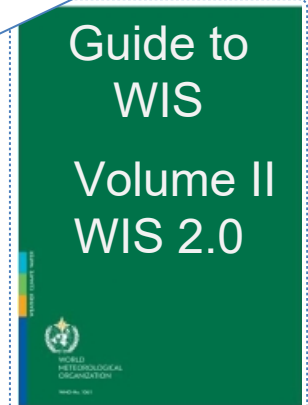
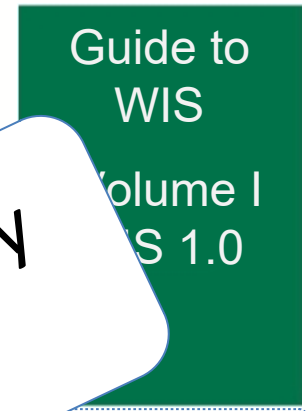
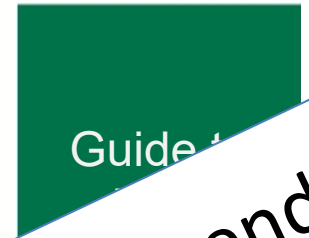
WIS2 regulatory material

June 2023 Cg-19



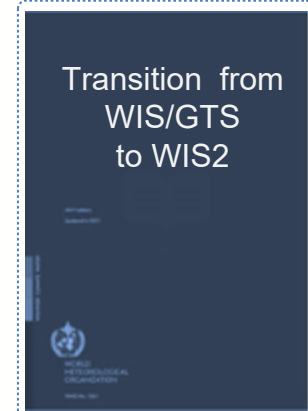
[Manual on WIS Volume II WMO Information System](#)

April 2024 INFCOM-3



doc 8.3(3)
UPDATE OF THE GUIDE TO THE WMO INFORMATION SYSTEM

All documents have been endorsed by INFCOM 3 (April 2024)



doc 8.3(2)
TRANSITION FROM WIS 1.0 AND GTS TO WIS 2.0, INCLUDING CAPACITY DEVELOPMENT



WMO OMM

STEP 2 : THE 'SATELLITE FLOOR'



WMO OMM

WIS2 regulatory material

- For each Earth domain, the experts from the domain, with the support of the WIS2 team will:
 - Further define the Topic Hierarchy and the filtering.
 - It must be noted that the Topic Hierarchy is a full description of the data
 - Develop the WCM and the data description
 - Each data producer has the responsibility to create and then publish the metadata
 - No data can be uploaded on WIS2, after 01/01/2025, without having a metadata record

See Anna Milan's talk



WMO OMM

WIS 2.0 topic hierarchy

Level	Name	Description
1	channel	Location of where the data originates from (data providers [origin] or global services [cache])
2	version	Alphabetical version of the topic hierarchy (currently a)
3	system	Fixed value of wis2 for WIS2
4	centre-id	Acronym as specified by member and endorsed by the PR of the country and by WMO
5	resource-type	WIS2 resources types (data , metadata , report [from monitoring activities])
6	data-policy	Data policy as defined by the WMO Unified Data Policy. Notifications for core and recommended data are available by subscription to Global Brokers. recommended data are downloaded from the original NC/DCPC and may require authentication/authorisation
7	earth-system-discipline	As per Annex 1 of resolution 1 Cg-Ext-2021
8	earth-system-discipline-category	As proposed by domain experts and further approved by INFCOM
9	name of the satellite	
10	name of the instrument	



Examples:

origin/a/wis2/int-eumetsat/data/core/weather/space-based-observations/meteosat-11/seviri – To be confirmed
cache/a/wis2/ca-eccc-msc/data/core/weather/surface-based-observations/synop

WIS 2.0 metadata

The diagram illustrates the structure of WIS 2.0 metadata using two examples: a KNMI dataset (draft) and a publisher contact record. A central blue banner states: **Conforms with OGC API Records - geoJson**. Callout boxes point to specific fields in the JSON metadata:

- Geometry (extent)**: Points to the `geometry` field in the KNMI dataset.
- Identifier**: Points to the `identifier` field in the KNMI dataset.
- Title**: Points to the `title` field in the KNMI dataset.
- Description**: Points to the `description` field in the KNMI dataset.
- Keywords**: Points to the `keywords` field in the KNMI dataset.
- Publisher contact**: Points to the `contacts` field in the KNMI dataset.
- Publisher contact (cont.)**: Points to the `deliveryPoint` field in the publisher contact record.
- Data policy**: Points to the `dataPolicy` field in the publisher contact record.
- Rights**: Points to the `rights` field in the publisher contact record.
- Data access (files)**: Points to the `dataAccessFiles` field in the publisher contact record.
- Data access (API) with security info**: Points to the `dataAccessAPI` field in the publisher contact record.
- Data access (notifications)**: Points to the `dataAccessNotifications` field in the publisher contact record.
- Additional info (OSCAR/Surface)**: Points to the `additionalInfoOSCAR` field in the publisher contact record.
- Additional info (Developer docs)**: Points to the `additionalInfoDeveloperDocs` field in the publisher contact record.
- License**: Points to the `license` field in the publisher contact record.
- Citation**: Points to the `citation` field in the publisher contact record.
- Time (extent) and update frequency**: Points to the `time` field in the publisher contact record.

```
1 {
2   "id": "urn:wmo:nd:nl-knmi-nmc:Actuele10mindataKNMIstations-2",
3   "conformsTo": [
4     "http://wis.wmo.int/spec/wcsp/2/conf/core"
5   ],
6   "type": "Feature",
7   "geometry": {
8     "type": "Polygon",
9     "coordinates": [
10      [
11        [
12          -68.5,
13          12
14        ],
15        [
16          -68.5,
17          55.7
18        ],
19        [
20          7.4,
21          55.7
22        ],
23        [
24          7.4,
25          12
26        ],
27        [
28          -68.5,
29          12
30        ]
31      ]
32    ]
33  },
34  "properties": {
35    "identifier": "urn:wmo:nd:nl-knmi-nmc:Actuele10mindataKNMIstations-2",
36    "title": "Meteo data - actual synoptic observations KNMI the Netherlands per 10 minutes",
37    "description": "KNMI collects observations from the automatic weather stations situated in the Netherlands and BES islands on locations such as aerodromes and North Sea platforms. In addition, wind data from KNMI wind poles are included. The weather stations report every 10 minutes meteorological parameters such as temperature, relative humidity, wind, air pressure, visibility, precipitation, and cloud cover. The number of parameters differs. The file for the past 10 minutes is available a few minutes later and contains a timestamp denoting the end of the observation period in UTC. At a station's observations may not be immediately available. Files are updated with missing data up to 4 hours later.",
38    "keywords": [
39      "surface weather",
40      "temperature",
41      "observations",
42      "meteorology"
43    ],
44    "themes": [
45      {
46        "concepts": [
47          {
48            "id": "weather"
49          }
50        ],
51        "scheme": "https://codes.wmo.int/topic-hierarchy/earth-system-disciplines"
52      },
53      {
54        "concepts": [
55          {
56            "id": "Surface observations"
57          }
58        ],
59        "scheme": "https://github.com/wmo-im/typhoon"
60      },
61      {
62        "concepts": [
63          {
64            "id": "weather"
65          }
66        ],
67        "scheme": "https://github.com/wmo-im/wis2"
68      },
69      {
70        "concepts": [
71          {
72            "id": "continual"
73          }
74        ],
75        "scheme": "https://standards.iso.org/iso/19339/rel-001/iso-19339-01.html#AMD_FrequencyCode"
76      }
77    ],
78    "language": "en",
79    "type": "dataset",
80    "created": "2023-01-01T00:00:00Z",
81    "updated": "2023-12-05T00:00:00Z",
82    "contacts": [
83      {
84        "addresses": [
85          {
86            "deliveryPoint": [
87              "Utrechtseweg 297"
88            ],
89            "city": "De Bilt",
90            "postalCode": "3731 GA",
91            "country": "Netherlands"
92          }
93        ],
94        "roles": [
95          "host"
96        ]
97      }
98    ],
99    "organization": "Koninklijk Nederlands Meteorologisch Instituut (KNMI)",
100   "position": "KNMI Data Platform",
101   "hoursOfService": "0800h - 1600h CEST/CET",
102   "phones": [
103     {
104       "value": "+31302206911"
105     }
106   ],
107   "emails": [
108     {
109       "value": "data@knmi.nl"
110     }
111   ],
112   "dataPolicy": "Data, without charge and with no conditions on use. Users are requested to attribute (KNMI 2021)",
113   "rights": "Data, without charge and with no conditions on use. Users are requested to attribute (KNMI 2021)",
114   "dataAccessFiles": [
115     {
116       "url": "https://open-data.wmo.int/datasets/Actuele10mindataKNMIstations/versions/2/files",
117       "format": "SUFR format"
118     }
119   ],
120   "dataAccessAPI": {
121     "url": "https://dataplatforn.knmi.nl/edr/v1/collections/observations",
122     "security": {
123       "default": {
124         "type": "http",
125         "scheme": "basic",
126         "description": "Please request an API key via https://developer.dataplatforn.knmi.nl/open-data-api-token"
127       }
128     }
129   },
130   "dataAccessNotifications": {
131     "url": "https://dataplatforn.knmi.nl/edr/v1/collections/observations",
132     "channel": "origin/a/wis2/nl-knmi-nmc/data/core/weather/surface-based-observations/synop",
133     "type": "application/json",
134     "rel": "items",
135     "title": "Data access (notifications)"
136   },
137   "additionalInfoOSCAR": {
138     "url": "https://oscar.wmo.int/surface/rest/api/search/station/?operatingStatus=Operational&territoryName=NLD&longitudeMin=-68.5&longitudeMax=7.4&latitudeMin=12.0",
139     "type": "application/json",
140     "rel": "stations",
141     "title": "Stations"
142   },
143   "additionalInfoDeveloperDocs": {
144     "url": "https://english.knmi.nl/open-data/actuele10mindataknmistations",
145     "type": "text/html",
146     "rel": "related",
147     "title": "Documentation"
148   },
149   "license": "CC BY 4.0 Deed | Attribution 4.0 International | Creative Commons",
150   "citation": "Koninklijk Nederlands Meteorologisch Instituut (KNMI) | Meteo data - actual synoptic observations KNMI the Netherlands per 10 minutes | Created 2023-01-01 | urn:wmo:nd:nl-knmi-nmc:Actuele10mindataKNMIstations-2 | https://creativecommons.org/licenses/by/4.0/ | CC BY 4.0 Deed"
151 }
152
153 {
154   "type": "Feature",
155   "geometry": {
156     "type": "Point",
157     "coordinates": [
158       4,
159       52
160     ]
161   },
162   "properties": {
163     "type": "publisher contact",
164     "title": "Publisher contact (cont.)"
165   }
166 }
167
168 {
169   "type": "Feature",
170   "geometry": {
171     "type": "Point",
172     "coordinates": [
173       4,
174       52
175     ]
176   },
177   "properties": {
178     "type": "data policy",
179     "title": "Data policy"
180   }
181 }
182
183 {
184   "type": "Feature",
185   "geometry": {
186     "type": "Point",
187     "coordinates": [
188       4,
189       52
190     ]
191   },
192   "properties": {
193     "type": "rights",
194     "title": "Rights"
195   }
196 }
197
198 {
199   "type": "Feature",
200   "geometry": {
201     "type": "Point",
202     "coordinates": [
203       4,
204       52
205     ]
206   },
207   "properties": {
208     "type": "data access (files)",
209     "title": "Data access (files)"
210   }
211 }
212
213 {
214   "type": "Feature",
215   "geometry": {
216     "type": "Point",
217     "coordinates": [
218       4,
219       52
220     ]
221   },
222   "properties": {
223     "type": "data access (API) with security info",
224     "title": "Data access (API) with security info"
225   }
226 }
227
228 {
229   "type": "Feature",
230   "geometry": {
231     "type": "Point",
232     "coordinates": [
233       4,
234       52
235     ]
236   },
237   "properties": {
238     "type": "data access (notifications)",
239     "title": "Data access (notifications)"
240   }
241 }
242
243 {
244   "type": "Feature",
245   "geometry": {
246     "type": "Point",
247     "coordinates": [
248       4,
249       52
250     ]
251   },
252   "properties": {
253     "type": "additional info (OSCAR/Surface)",
254     "title": "Additional info (OSCAR/Surface)"
255   }
256 }
257
258 {
259   "type": "Feature",
260   "geometry": {
261     "type": "Point",
262     "coordinates": [
263       4,
264       52
265     ]
266   },
267   "properties": {
268     "type": "additional info (Developer docs)",
269     "title": "Additional info (Developer docs)"
270   }
271 }
272
273 {
274   "type": "Feature",
275   "geometry": {
276     "type": "Point",
277     "coordinates": [
278       4,
279       52
280     ]
281   },
282   "properties": {
283     "type": "license",
284     "title": "License"
285   }
286 }
287
288 {
289   "type": "Feature",
290   "geometry": {
291     "type": "Point",
292     "coordinates": [
293       4,
294       52
295     ]
296   },
297   "properties": {
298     "type": "citation",
299     "title": "Citation"
300   }
301 }
302
303 {
304   "type": "Feature",
305   "geometry": {
306     "type": "Point",
307     "coordinates": [
308       4,
309       52
310     ]
311   },
312   "properties": {
313     "type": "time (extent) and update frequency",
314     "title": "Time (extent) and update frequency"
315   }
316 }
```

Example: KNMI dataset (draft)

STEP 3 : THE IMPLEMENTATION



WMO OMM

WIS2 Node

- A WIS2 Node, for publishing data, will need the following software components:
 - A HTTPS server (NGINX, Apache,...) hosting the data and an MQTT broker (Mosquitto, EMQX, VerneMQ, HiveMQ,...)
 - Both tools being off-the-shelf solutions. Some being opensource, other being commercial software
 - A « glue » to prepare the WIS2 Notification Message to be published on the MQTT broker when new data is available
- As opposed to the GTS, WIS2 is not a *closed club* (*)
- All approved data sources can publish and get data from WIS2 directly:
 - EUMETSAT is publishing data on WIS2 since Autumn 2023

(*) : Data publishers on WIS2 have to be endorsed by the Permanent Representative (or equivalent) to be allowed to make their data available

DCP and DBNET

- At the moment, DCPs are providing the data through the GTS (eg. Eumetsat) and/or via a website (eg. USA)
 - DCP should consider adding/replacing a WIS2 compliant method to the existing data distribution mechanism
 - Depending on the data policy this could be core (free and unrestricted) or recommended (with access control) – see WMO Res. 1
 - WIS2 supports both
 - According to the WIS terminology DCP would be DCPC (!)
- Users of DBNET data would also benefit from the delivery of data using WIS2
- WMO Secretariat and the WIS2 team will be happy to support CGMS into the transition to WIS2 ensuring an easy and consistent delivery of data to users

Thank you.



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