World Meteorologi

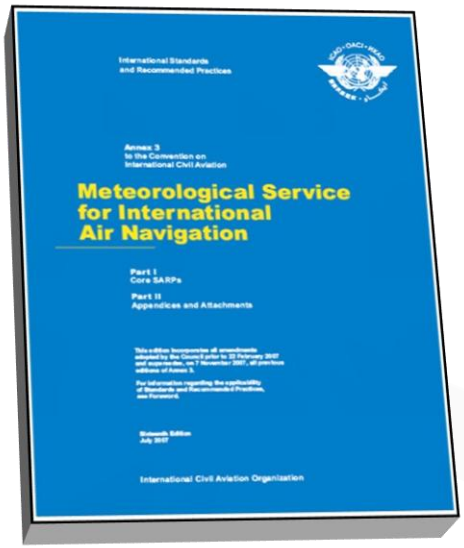
Weather • Climate • Water

# WMO Codes Registry: http://codes.wmo.int

## web-based publication of the Manual on Codes

Jeremy Tandy, 20 November 2013

# Motivation: XML-encoded data exchange standards



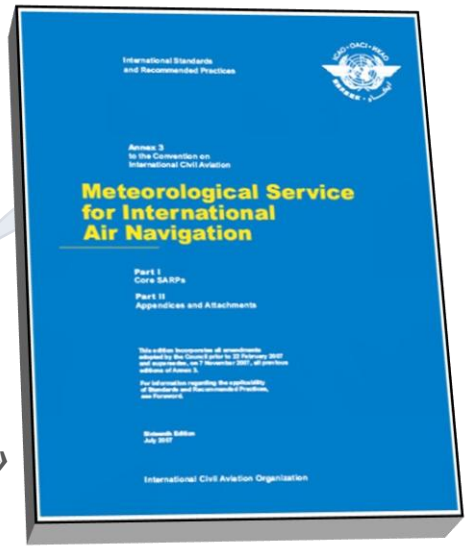

***ICAO Annex 3 / WMO No. 49 II***

***Meteorological Service for International Air Navigation***

***Amendment 76 (2013) to ICAO Annex 3 shall, for states in a position to do so to, permit bilateral exchange of OPMET data via XML***

***TAF***
***METAR/SPECI***
***SIGMET***

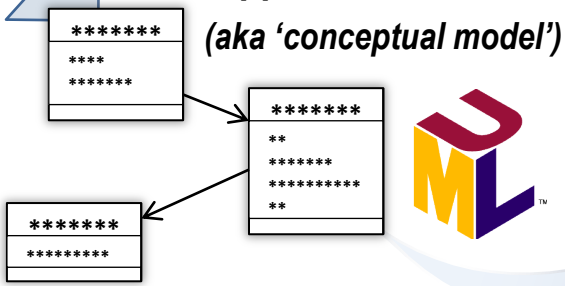
# Model-driven approach to data exchange standards




*« formalised as »*

*Application Schema*

*(aka 'conceptual model')*




*Geographic Information*
*[ISO 19100-series]*

ISO

*« validated against »*

XSD

SCH

*TAF*
*METAR/SPECI*
*SIGMET*

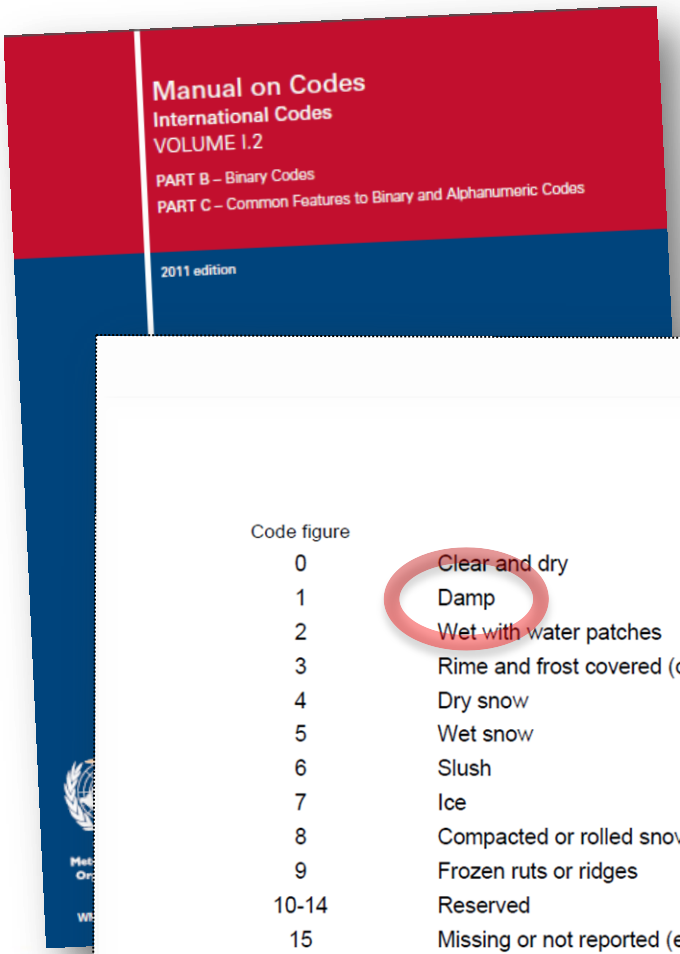
GML

*« serialized as »*

***Conformance to Technical Regulation requires strong validation***

***IWXXM**: ICAO Weather Information Exchange Model*

# Nominal value-types; regulated set of terms (code-table)




**0 20 086**

***Runway deposits***

| Code figure | | |
|---|---|---|
| 0 | Clear and dry | |
| 1 | Damp | |
| 2 | Wet with water patches | |
| 3 | Rime and frost covered (depth normally less than 1 | |
| 4 | Dry snow | |
| 5 | Wet snow | |
| 6 | Slush | |
| 7 | Ice | |
| 8 | Compacted or rolled snow | |
| 9 | Frozen ruts or ridges | Operational |
| 10-14 | Reserved | Operational |
| 15 | Missing or not reported (e.g. due to runway clearance in progress) | Operational |

*Excerpt from BUFR edition 4 Code- and Flag-tables*

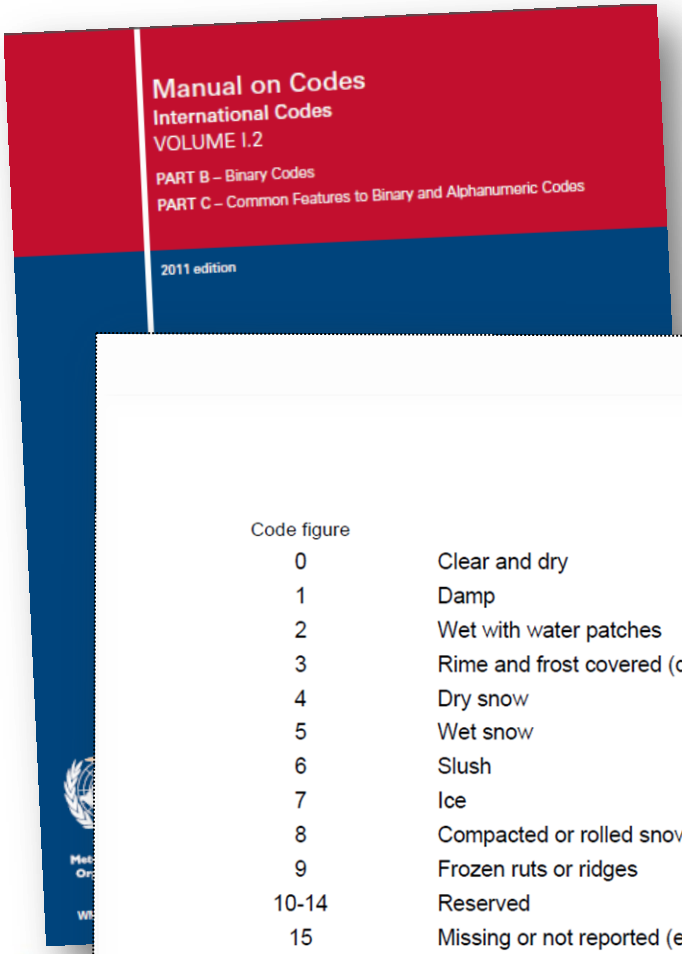
IWXXM METAR/SPECI

«DataType»
AerodromeRunwayState

+ runway : Runway [0..1]
+ cleared : Boolean [0..1]
+ contamination : RunwayContamination [0..1]
+ snowClosure : Boolean [0..1]
+ depositType : RunwayDeposits [0..1]
+ depthOfDeposit : DepthOfDeposit [0..1]
+ brakingAction : BrakingAction [0..1]
+ frictionCoefficient : FrictionCoefficient [0..1]

***Technical Regulation mandates the use of terms only from a specified controlled vocabulary***

# Design choice: avoid use of «enumeration» entities (*fragile*)

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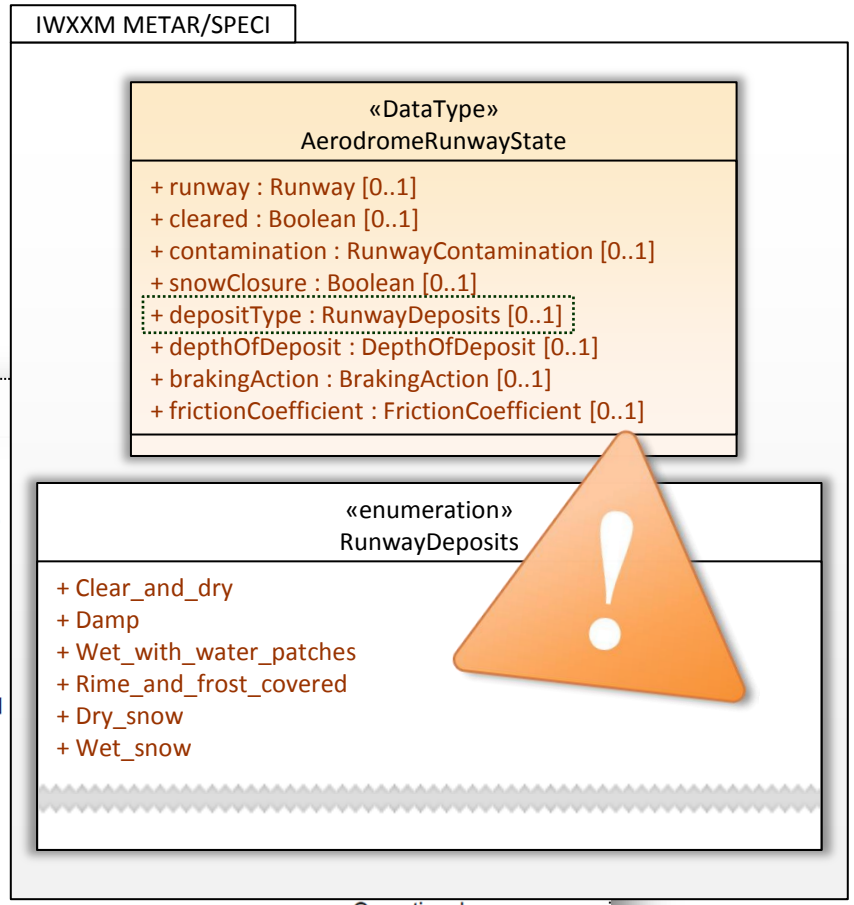
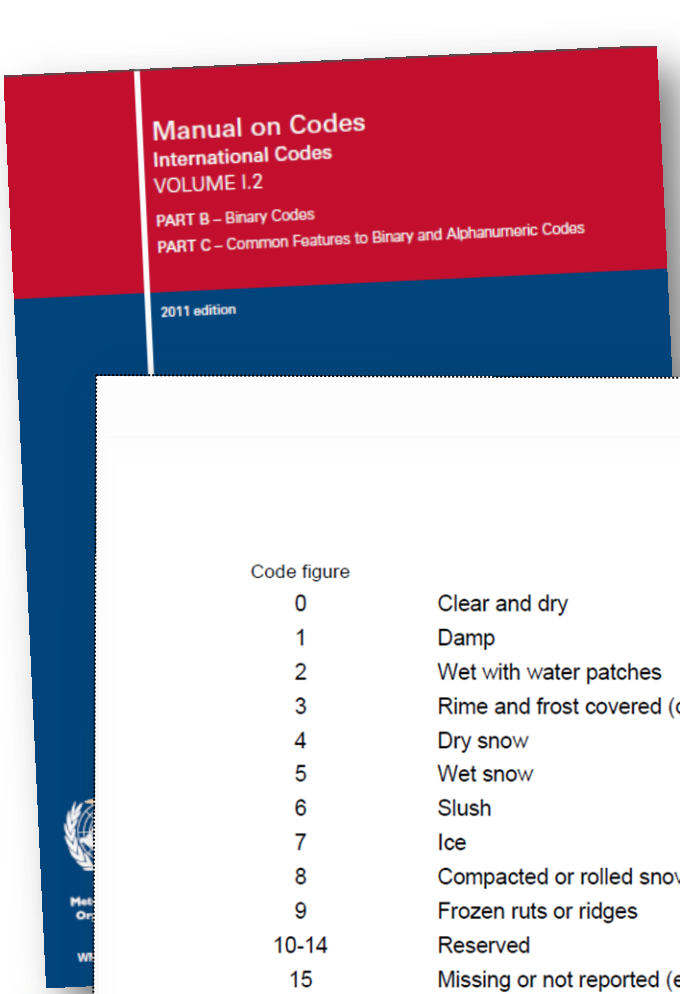


# Best practice: use «CodeList» class (*external reference*)

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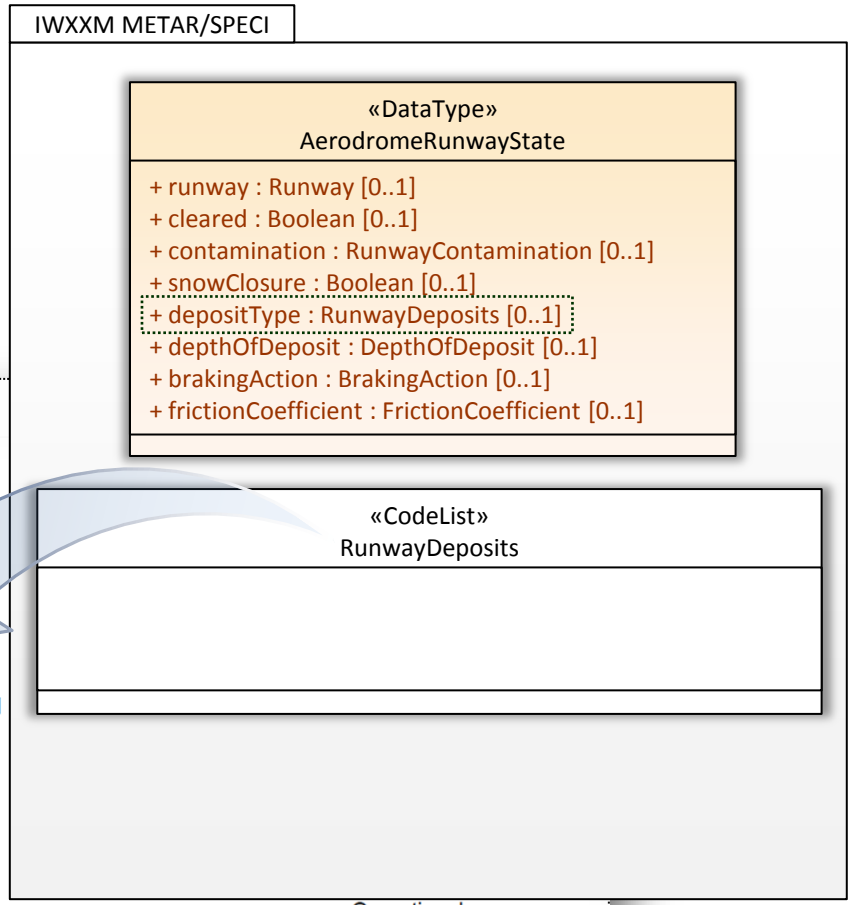
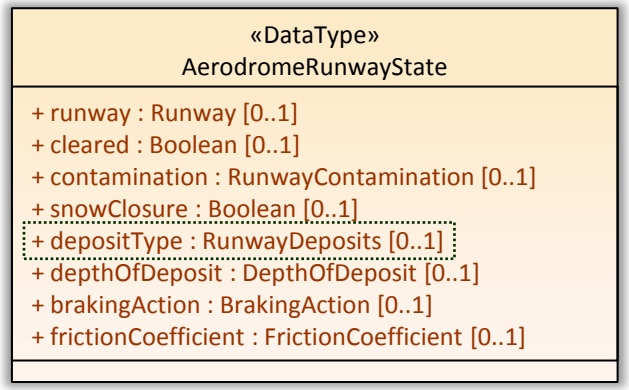


# Referencing terms using canonical labels

```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType>
         Damp
      </iwxxm:depositType>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```




***Canonical labels don't work well as identifiers as their use is error prone …***

# Referencing terms using canonical labels

```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType>
         DAMP
      </iwxxm:depositType>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```

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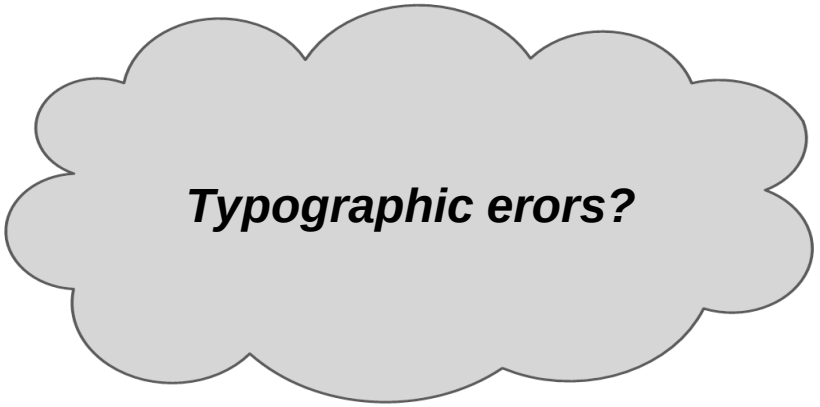
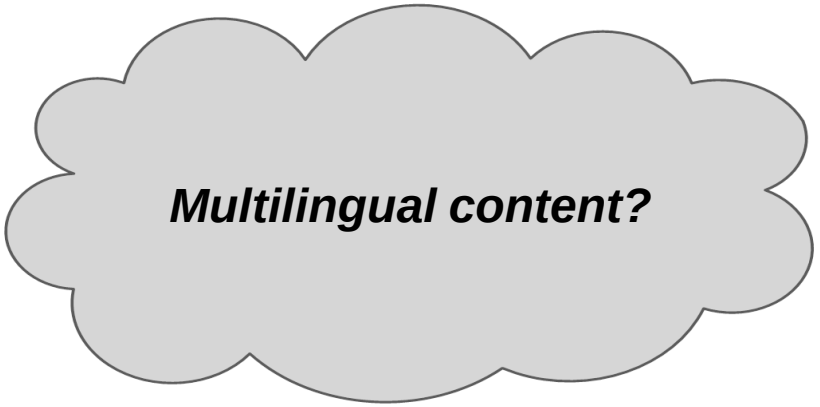
```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType>
         Dammp
      </iwxxm:depositType>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```



# Referencing terms using canonical labels

```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType>
         влажный
      </iwxxm:depositType>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```



# Referencing terms using local identifiers; “code-figure”

```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType>
         1
      </iwxxm:depositType>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```

***“1” what? Because XML is a generalised exchange format, there are no implied semantics like for BUFR and GRIB***

# Referencing terms using local identifiers; “code-figure”

```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType>
         0-20-086/1
      </iwxxm:depositType>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```

***Qualifying the code-figure with the code-table identifier is still fairly meaningless unless you’re a BUFR expert!***

# Referencing terms using local identifiers; “code-figure”

```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType>
         bufr4/codeflag/0-20-086/1
      </iwxxm:depositType>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```

***Adding context (e.g. BUFR edition 4, code- and flag-tables) helps – but who’s the publishing authority?***

# Referencing terms using global identifiers

```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType>
         wmo.int/bufr4/codeflag/0-20-086/1
      </iwxxm:depositType>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```

***We want to be sure that this is the authoritative version from WMO; prefix identifier with WMO's Internet domain name***

# Referencing terms using global identifiers; xlink & URN

```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType
         xlink:href="urn:foo:wmo.int/bufr4/codeflag/0-20-086/1"
         xlink:title="Damp"/>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```

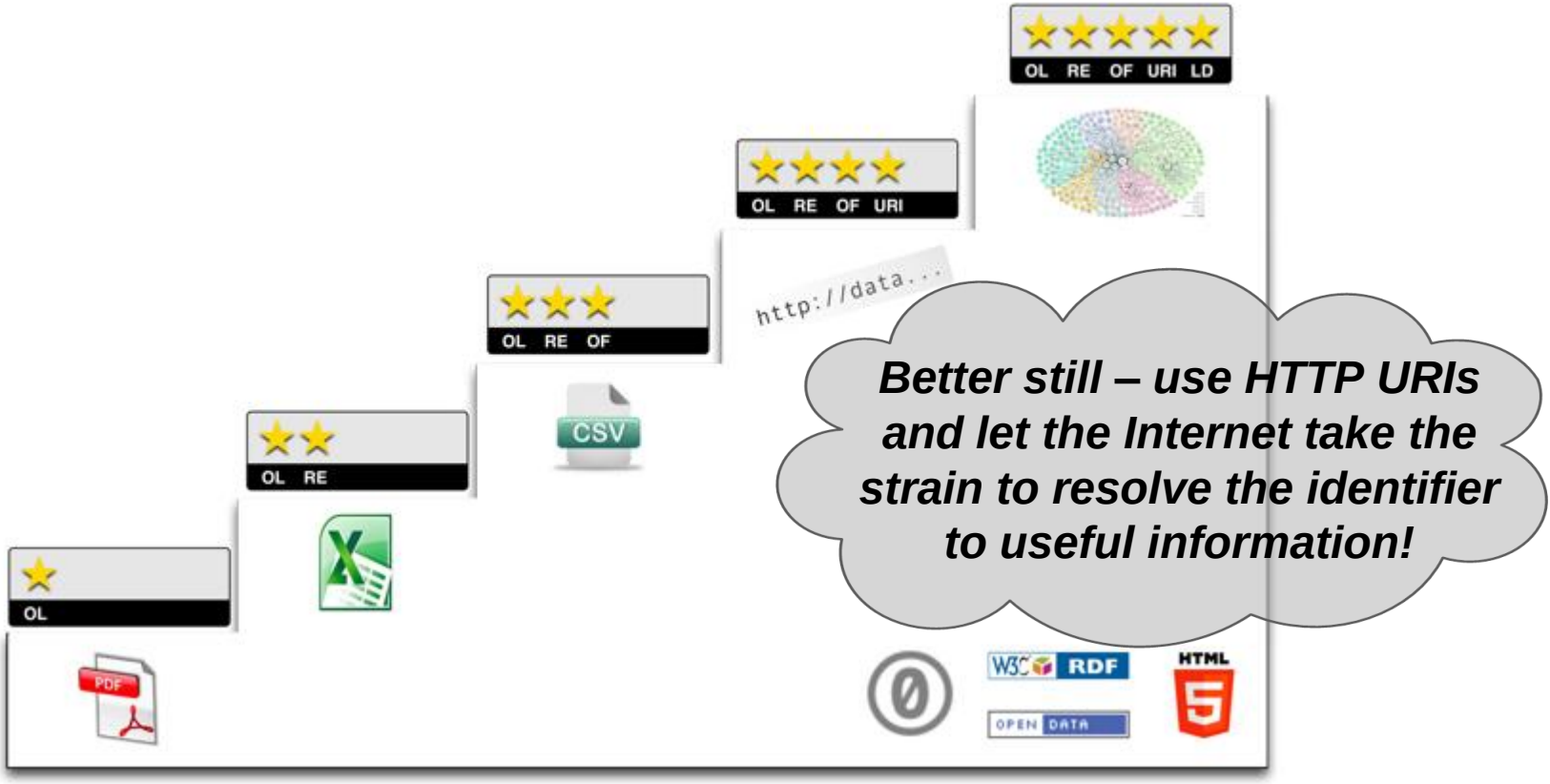
***A URN may be used – but then one needs additional knowledge to determine how to resolve the identifier***

***GML requires use of XLINK for «CodeList» references; the Locator Attribute "href" must be a URI***

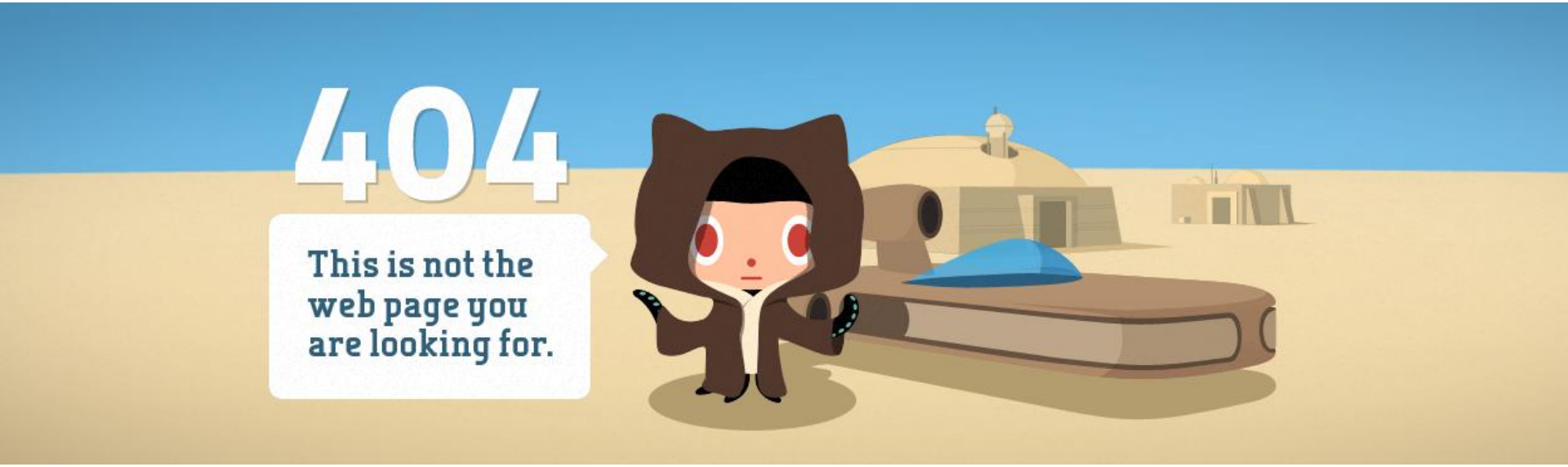
# Referencing terms using URIs; an Open Data approach

5 ★ Open Data scheme: the degree to which data is (re-)usable

★ ★ ★ ★ ***use URIs to denote things – so that people can point to your stuff***



# HTTP URI – it's just an identifier!




***A URI doesn't have to resolve to anything – but it's helpful if it does …***

***Don't confuse a URI with a URL; operational systems not connected to the Internet can still use URIs as identifiers***

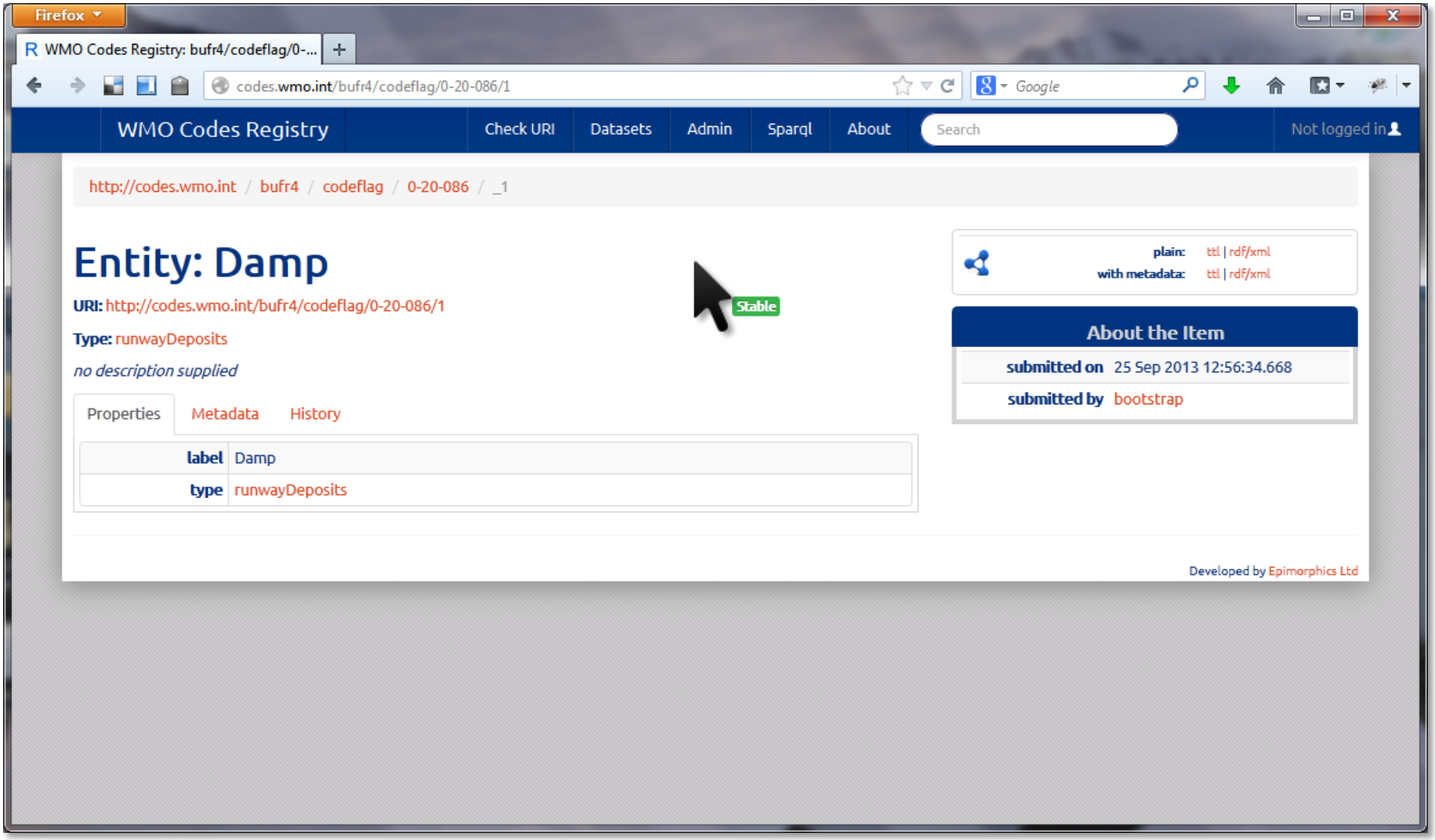
source: https://github.com

# The WMO Codes Registry service: resolving identifiers

```
<iwxxm:runwayState>
   <iwxxm:AerodromeRunwayState>
      <iwxxm:depositType
         xlink:href="http://codes.wmo.int/bufr4/codeflag/0-20-086/1"
         xlink:title="Damp"/>
   </iwxxm:AerodromeRunwayState>
</iwxxm:runwayState>
```

***"codes" sub-domain prefix added to wmo.int Internet domain name to enable redirection using DNS …***

# The WMO Codes Registry service: resolving identifiers

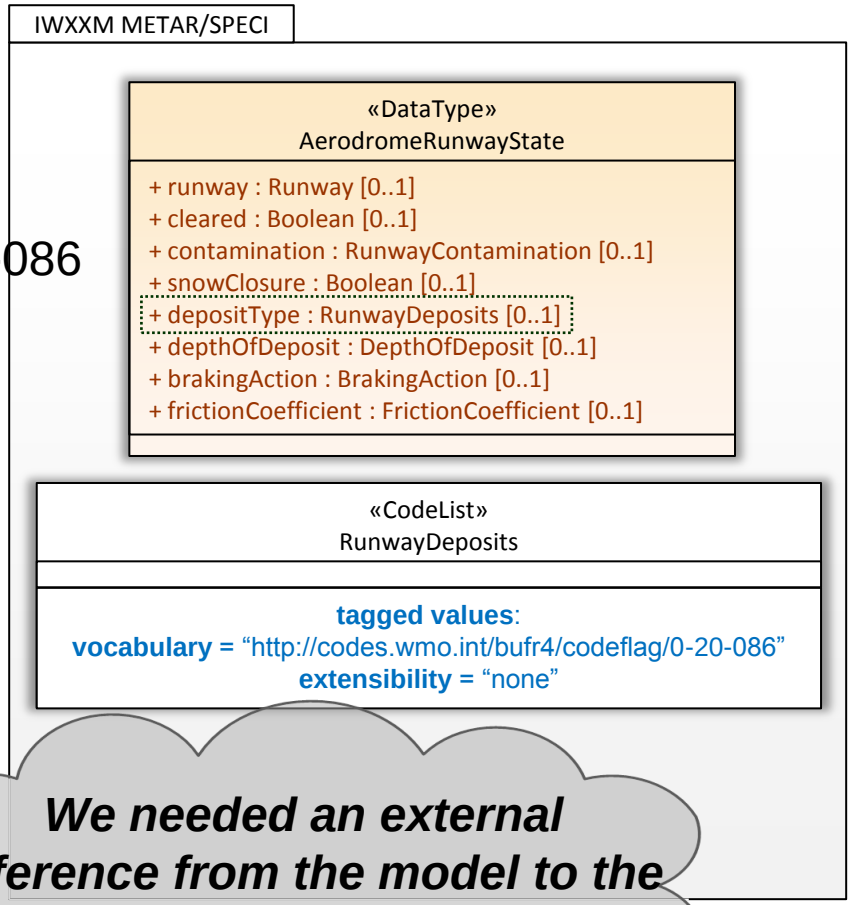


# Overview of WMO Codes Registry

- WMO Codes Registry is the Service that resolves these HTTP URIs
- Provides *useful* information about each identified resource or concept (as determined by WMO) – using content negotiation to render both human- and machine-readable content (HTML, RDF/XML, Turtle & JSON-LD)
- Newly deployed: September 2013
- Operated by Met Office  on behalf of WMO
- Founded on Linked Data principles and RDF
- Built using open-source Registry software developed by UK Government

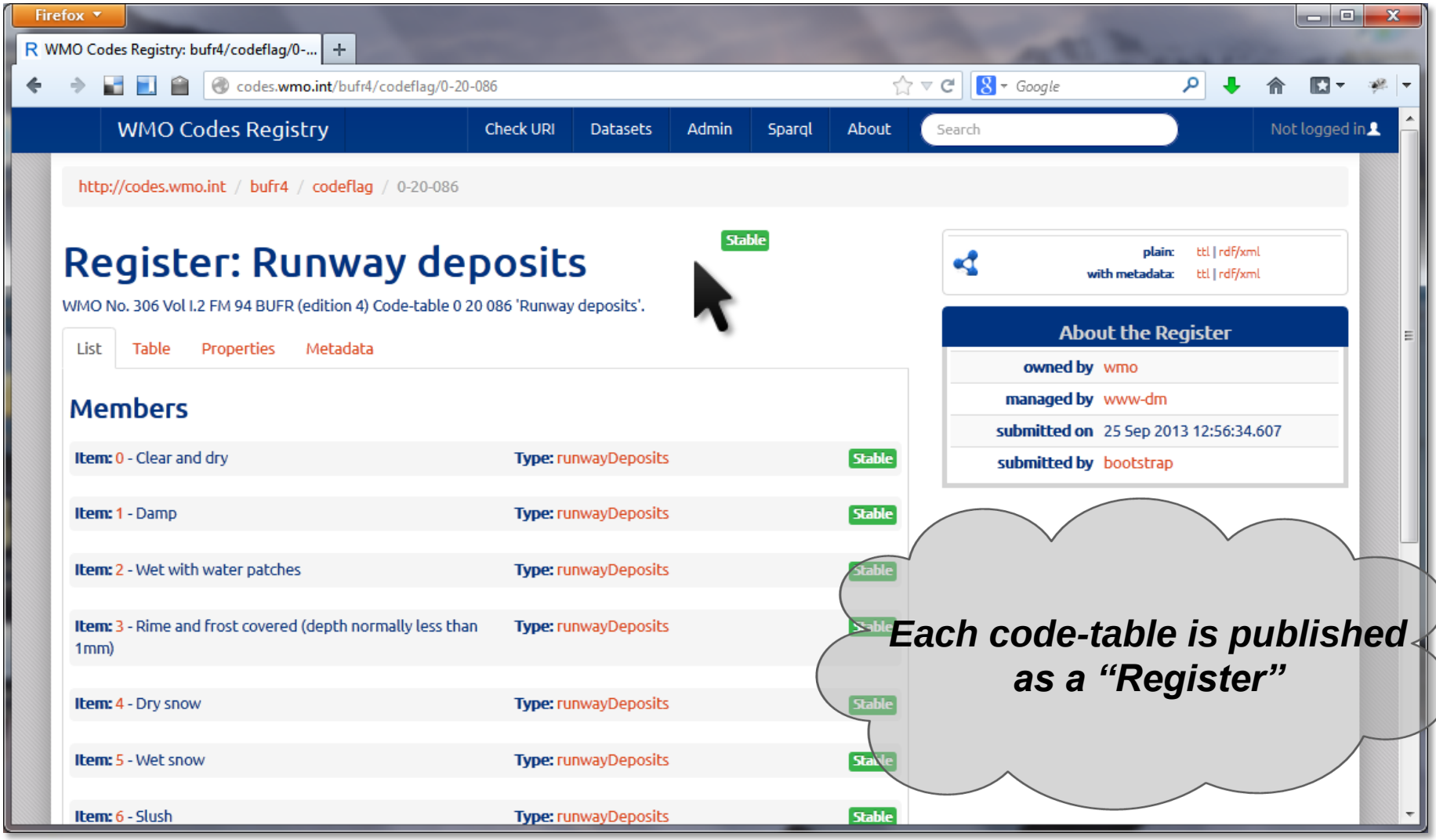
# HTTP URIs assigned to code-tables too …

```
<complexType name="RunwayDepositsType">
  <annotation>
    <appinfo>
      <vocabulary>
        http://codes.wmo.int/bufr4/codeflag/0-20-086
      </vocabulary>
      <extensibility>none</extensibility>
    </appinfo>
    <documentation>
      Type of deposit on a runway [..snip..]
    </documentation>
  </annotation>
  <complexContent>
    <extension base="gml:ReferenceType"/>
  </complexContent>
</complexType>
```

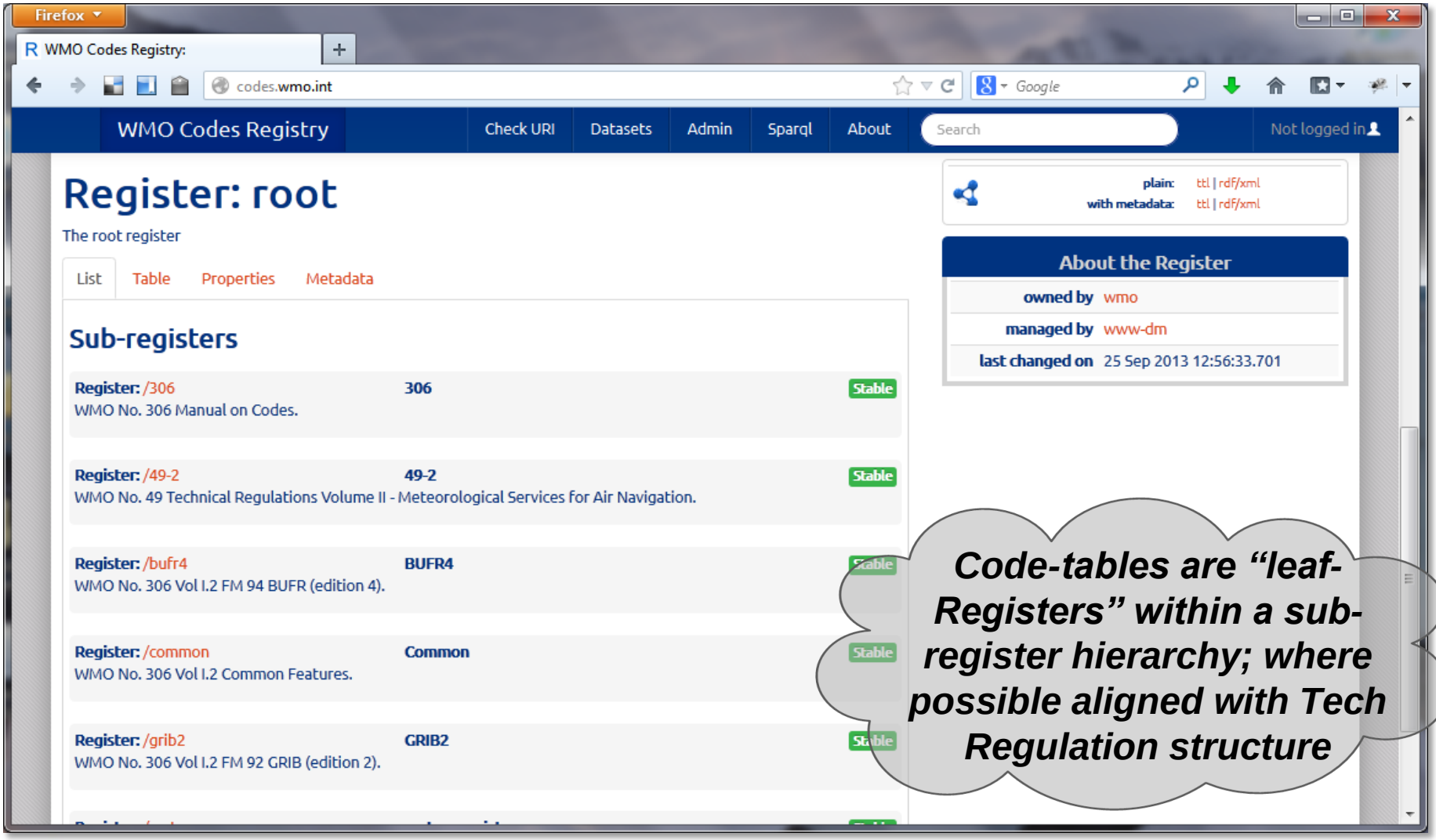



***We needed an external reference from the model to the code-table; "vocabulary" tagged value is code-table URI***

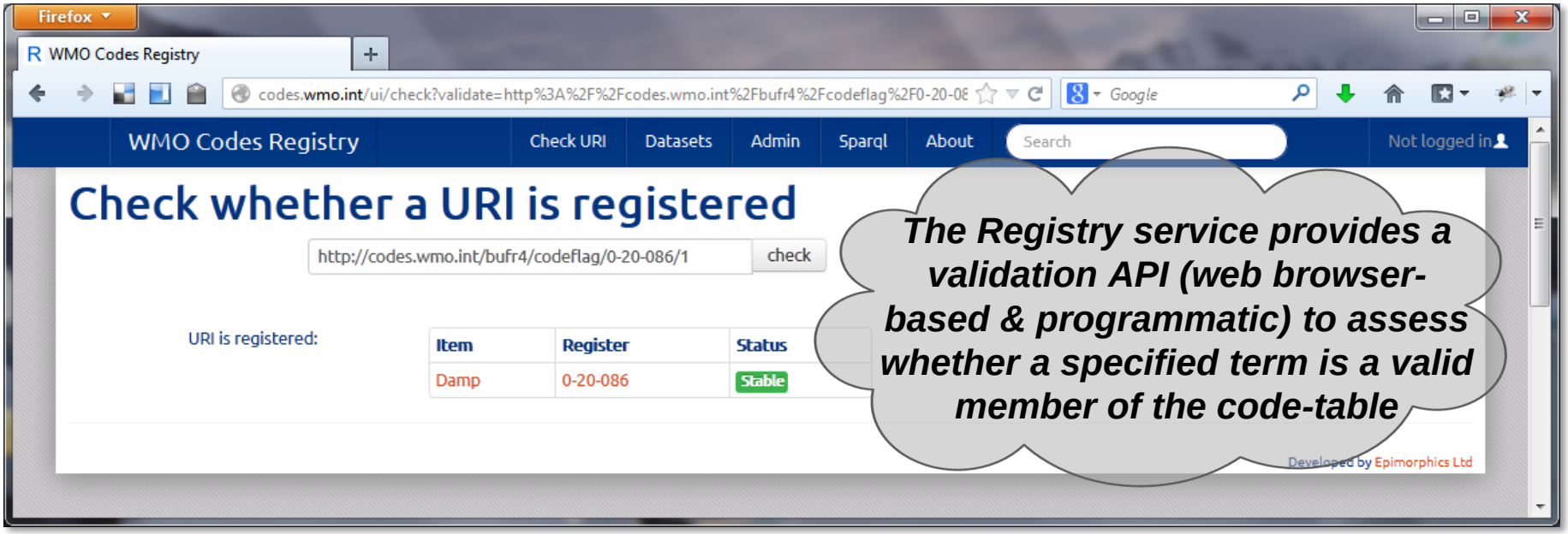
# HTTP URIs assigned to code-tables too …



# Register hierarchy aligned with WMO Technical Regulation



# Answering the "membership" question: *is this a valid term?*

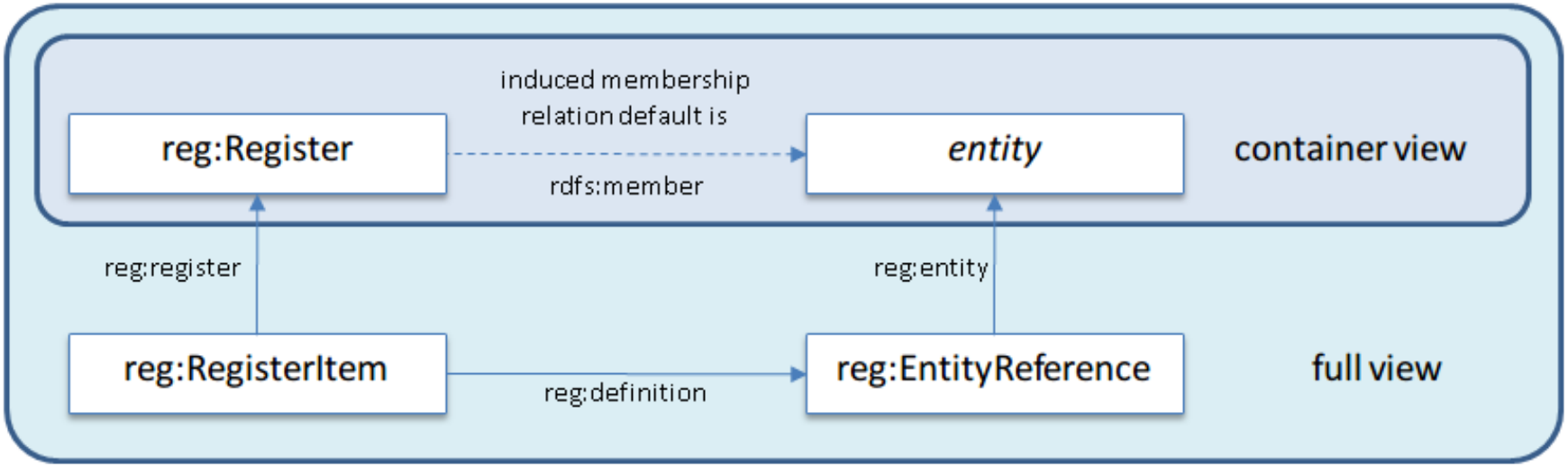



**[POST]** `http://codes.wmo.int/bufr4?`

`validate=http://codes.wmo.int/bufr4/codeflag/0-20-086/1`

**[HTTP 200 OK]** `http://codes.wmo.int/bufr4/codeflag/0-20-086/1 is`
`http://codes.wmo.int/bufr4/codeflag/0-20-086/_1`

# Sophisticated underpinning data model & simple views



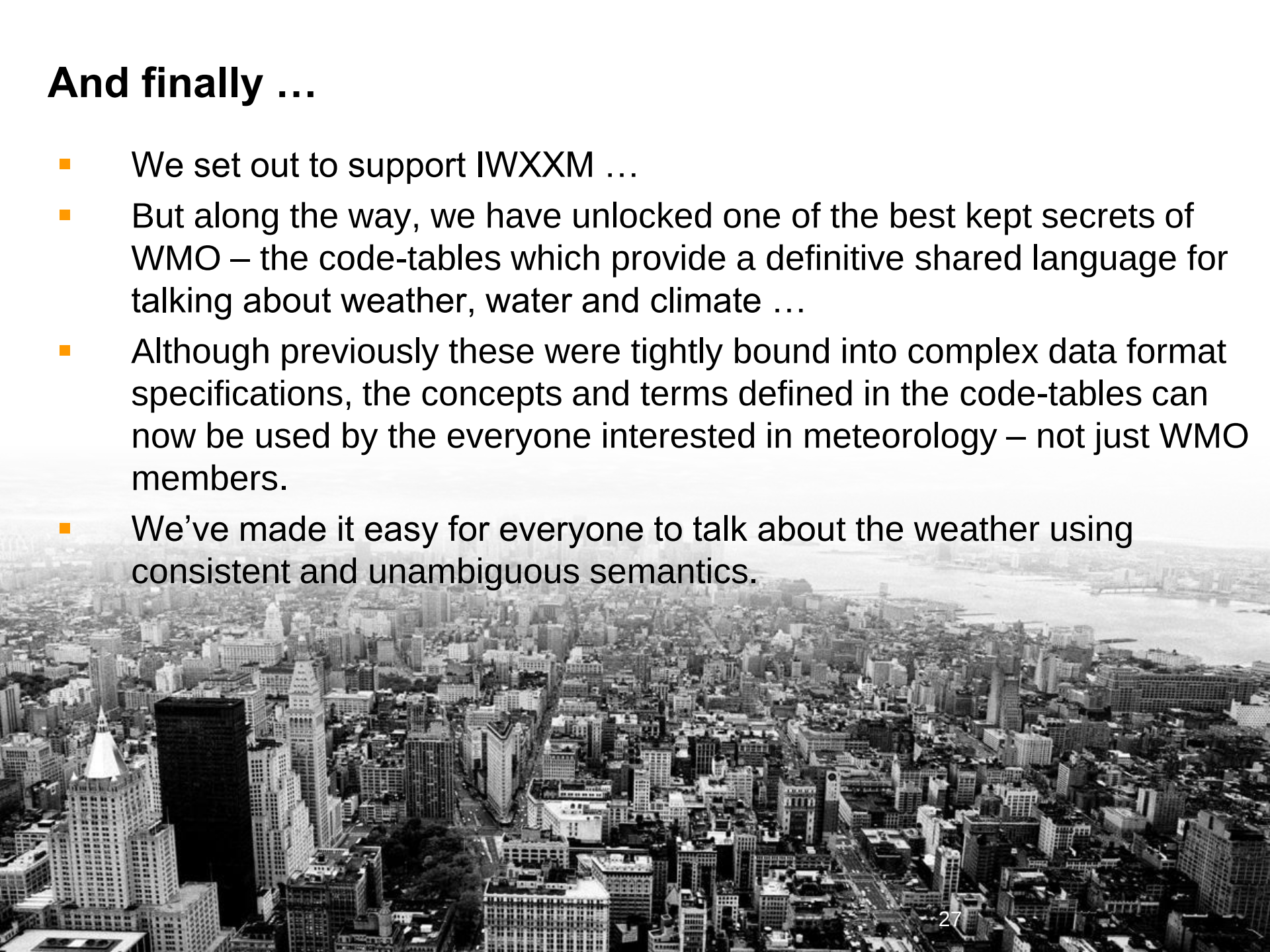

- Data model derived from ISO 19135 Procedures for item registration
- RegisterItem: relates an *entity* to a specific Register – like the index-card in a library …
- RegisterItem identifiers use a underscore "_" syntax
- RegisterItem defines the status of an *entity* with respect to the Register
- Life cycle management of terms built in
- RegisterItems are versioned – enabling traversal through historical changes

# Current status and future plans

- WMO Codes Registry is available now!
- Web-application and RESTful API – both for READ and UPDATE operations
- Authentication via OpenID (Google); self-registration permitted – *only members of WMO Expert Team will authorized to make changes*
- Current coverage of WMO No. 306 is sparse as initial objective is support for IWXXM; commitment from WMO to expand coverage and add multilingual content
- Planned enhancements include:
  - support for offline operational systems (export & validation)
  - improvements to User Interface (less technical)
  - addition of ‘back-catalogue’ terms from previous versions of TDCF

# And finally …

- We set out to support IWXXM …
- But along the way, we have unlocked one of the best kept secrets of WMO – the code-tables which provide a definitive shared language for talking about weather, water and climate …
- Although previously these were tightly bound into complex data format specifications, the concepts and terms defined in the code-tables can now be used by the everyone interested in meteorology – not just WMO members.
- We've made it easy for everyone to talk about the weather using consistent and unambiguous semantics.



World Meteorological Organization

Weather · Climate · Water

# Thank you for your attention

For further information please refer to the User Guide, FAQ and technical documentation