



Message Queueing for WIS 2.0 2021/09 Status

Peter Silva
Shared Services Canada

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World Meteorological Organization
Organisation météorologique mondiale

Project Objectives

- Replace GTS (WMO-386) real-time data transfer in WIS
- "In WIS" means aligning with WIS 2.0 principles
- Integrity, Encryption & Authentication when appropriate
- Ensure performance is reasonable
- Make it easier and broader than traditional GTS



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MQP Technical Team

- Peter Silva, Shared Services Canada
- Antje Schremmer, Deutscher Wetter Dienst (Germany)
- David Podeur, MétéoFrance
- Ian McDonald, Eumetsat
- Jan Osusky, HMEI (private sector)
- Ren Ozeki, Japan Meteorological Agency (new!)
- Renan Rodriguez, INMET (Brazil)
- WMO: Timo Proscholdt, Enrico Fucile, Rémy Giraud



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Project plan

- Establish discussion platform
- Agree to initial set of protocols and methods
- Run pilots (multiple implementations) to validate agreements
- Iterate to clarify or address issues
- Establish reference implementations and test cases for validation
- As standard solidifies, broaden recommendation



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Establish Discussion Platform

- <https://github.com/wmo-im/GTStoWIS2>
- Each technical topic results in an issue being opened
- Issues announced for discussion at monthly meetings
- (no monthly meetings over the summer ;-)
- Anyone can review rationale for decisions (closed issues.)
- Weakness: no formal specifications yet



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Overview of MQP Proposal

- Have a file server (HTTPS or SFTP)
- When a new file is placed on the server, a message is published over an MQP broker (server software near the file server.)
- The publication includes a hierarchical topic, and a retrieval method
Click to add text
- Subscribers connect to the broker, indicate the topics of interest, receive messages on those topics, and download



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Details of Proposed MQP Method

- File Server Transfer Protocols: HTTPS & SFTP
- Message Queueing Protocols:
 - AMQP 0.9 (>90% of real-world usage, Rabbitmq) from finance...
 - AMQP 1.0 (very little usage) ISO Standard, Aviation Adopted.
 - MQTT 3.1 ISO Standard, from IOT, very popular.
 - MQTT 5 OASIS Standard, fixes scaling issues. Probably best
- JSON payload
- Readable topics replace GTS AHL



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Current JSON Payload

AMQP Topic: v03.wis.ca.cmc.upperair.04

```
{ "pubTime" : "20190120T045018.314854383",  
  "baseUrl" : "https://localhost/data/20190120",  
  "integrity": {"method": "sha512", "value": "A2KNxvks...S8qfSCw=="},  
  "relPath" : "WIS/CA/CMC/UpperAir/04/UANT01_CWAO_200445___15103.txt",  
  "size": 457,  
  "content": { "encoding": "utf-8", "value": "encoded bytes from the file" },  
  "retPath" : "4Pubsub/92c557ef-d28e-4713-91af-2e2e7be6f8ab"
```



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Sample Topic Breakdown

AMQP Topic:

v03.wis.ca.canadian_met_centre.upperair.aircraft.airep.north-atlantic

From Abbreviated Header Line (AHL): UANT01 CWAO
TTAAii CCCC

CCCC – Origin/authority of message -> ca.canadian_met_centre

TTAAii -> upperair.aircraft.airep.north-atlantic



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Topic mapper: Migrate GTS AHL data

Input (GTS AHL): UACN10_CYXL

Read the WMO 386 Attachment II tables A-D to decode into

Output (WIS topic):

- `ca/sioux_lookout_airport/upperair/aircraft/airep/ca/`

In future, no AHL used at all. But we have not looked at file names yet.



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Appropriate Security

- MQP convention "anonymous:anonymous" for web-style anonymous service. Otherwise Authenticated.
- HTTP can be anonymous or authenticated (BASIC AUTH or other schema defined by W3C, not WMO.)
- SFTP always authenticated.
- All protocols with an "S" (over TLS.)
- Message body include integrity checksum.



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Pilots in Progress

- (previous) GTS exchange Canada/Germany/France/Brazil
 - Demos in 2019, with earlier versions of proposals
 - Need to be restarted in the fall/winter once proposals updated.
 - Performance measurement should happen in winter 2022
- Collaboration in NetCDF (Antje Schremmer, Kai-Thorsten Wirt)
 - DWD publishing messages for netCDF datasets from NOAA (started.)
- Malawi observations (Enrico Fucile, Timo Pröschooldt)



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Future Work (1 year)

- Standardize File naming (replace AHL)
- Measure performance (using inlining and links judiciously)
- Re-start exchanges among centres (standardization work changed content, software updates in progress over the summer.)
- Iteration of topic tree (seeking input.)



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WIS 2 Principles in the project

Principle 1: WIS 2.0 adopts Web technologies and leverages industry best practices and open standards

- HTTPS, and SFTP adopted as open, adequate data transport protocols
- MQP ideally only for notifications, which web standards do not cover well (but optimizations allow some content embedding.)



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WIS 2 Principles in the project

Principle 2: WIS 2.0 uses Uniform Resource Locators (URL) to identify resources

- MQTT natively uses URLs to advertise topics.
- AMQP is a bit more complicated. Working with metadata committee on proposals
- MQP message payloads include download URLs



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WIS 2 Principles in the project

Principle 3: WIS 2.0 prioritizes use of public telecommunications networks (i.e., Internet) when publishing digital resources

- Project can use any TCP/IP network, all trials done on public Internet.
- Current pilots available on Internet.



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WIS 2 Principles in the project

Principle 4: WIS 2.0 requires provision of Web service(s) to access or interact with digital resources (e.g., data, information, products) published using WIS

- File transfer over HTTPS is the normal retrieval method
- MQP supplies URLs for clients to download



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WIS 2 Principles in the project

Principle 6: WIS 2.0 will add open standard messaging protocols that use the publish-subscribe message pattern to the list of data exchange mechanisms approved for use within WIS and GTS

- The TT is standardizing a form of publish-subscribe for adoption by WIS to replace GTS
- It leverages international standards by establishing a conventions for their usage



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WIS 2 Principles in the project

Principle 7: WIS 2.0 will require all services that provide real-time distribution of messages to cache/store the messages for a minimum of 24-hours, and allow users to request cached messages for download

- The facilitation of real-time distribution is the primary purpose of MQP usage
- The web-cache is a natural component of the proposal



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WIS 2 Principles in the project

Principle 8: WIS 2.0 will adopt direct data exchange between provider and consumer

- Direct data exchange supported and encouraged
- MQP also permit multi-hop transfers



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WIS 2 Principles in the project

Principle 9: WIS 2.0 will phase out the use of routing tables and bulletin headers

- Brokers maintain no fixed routing table
- Brokers publish new information in standardized topics
- Subscribers inform brokers of the topics of interest
- topic tree has been standardized by this committee
- GTS filenames include bulletin headers: next target



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WIS 2 Principles in the project

Principle 10: WIS 2.0 will provide a Catalogue containing metadata that describes both data and the service(s) provided to access that data

- MQP is a real-time message transfer technology, not appropriate to supply a catalogue, however messages can be used to build a catalogue
- MQP products already integrated into German WIS Catalog
- Working with ET-Metadata/TT-WISMD to ensure they can provide appropriate entries for MQP real-time feeds



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WIS 2 Principles in the project

- Principle 11:** WIS 2.0 encourages data providers to publish metadata describing their data and Web services in a way that can be indexed by commercial search engines
- MQP proposal is to have Web Accessible Folders (WAF) where new files are advertised by JSON messages
 - Best case: Internet search engines could use MQP to update their catalogues in real-time
 - Worst case: search engines can traverse the WAF as robots do



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Project data standards

- Project transfers all data as files
- Does not prescribe file formats
- File Naming is to be addressed in fall 2021
- Files should have an extension corresponding to their format
 - .grib, .bufr, .cap, .txt



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Protocol Standards

- WMO 386 (to be replaced)
- AMQP 1.0 (ISO/IEC 19464:2014)
- MQTT v3 (ISO/IEC 20922:2016)
- MQTT v5 (OASIS 2016-03-07)
- SFTP aka. SECSH (IETF RFC 4254 + updates)
- HTTPS (IETF RFC 2818 + updates)
- JSON (ISO/IEC 21778:2017)



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Project metadata standards

- Current standard specifies use of minimum metadata for transmission
- JSON payload permits inclusion of arbitrary additional metadata
- Unnecessary metadata affects real-time transmission performance



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Data discovery

- Real-time feed can be used to update metadata discovery mechanisms
- This activity is a real-time transfer mechanism, not intended for discovery
- Working with ET-Metadata/TT-WISMD
- Topic trees can be integrated in discovery metadata at highest level



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Data exchange

- Project is/proposes a data exchange mechanism
- Pilots are demonstrations of data exchanges
- Complements other data exchange projects by providing a method of effective transfers in real-time
- Use of URL leaves it open to adopting future transfer protocols, such as S3, IPFS, etc...



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Input to WIS2

- Use of MQP for notifications fills a gap in standards; provides a necessary element for replacement of GTS by WMO members
- MQP notifications permit the standardization of large dataset exchanges currently done exclusively with bilateral agreements (NetCDF pilot)
- MQP notifications could be adopted by wider groups later
- Continued standardization, and pilots recommended for now



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Thank you
Merci

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