Tomorrow's Data Discovery and Availability Services at FMI

Ilkka Rinne / FMI

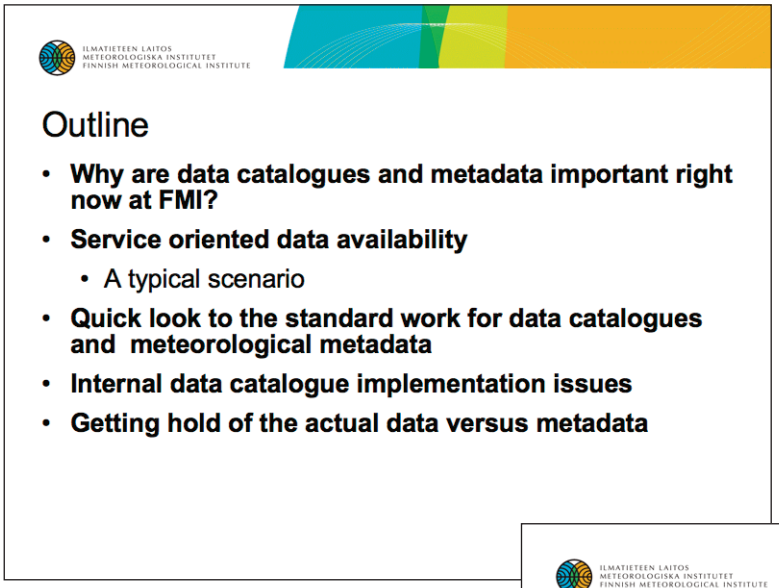
The amount and the variety of meteorological data necessary for accurate forecasting is increasing fast. Data discovery and availability services play an important role in efficiently finding the relevant data provided by both in-house and external data sources.

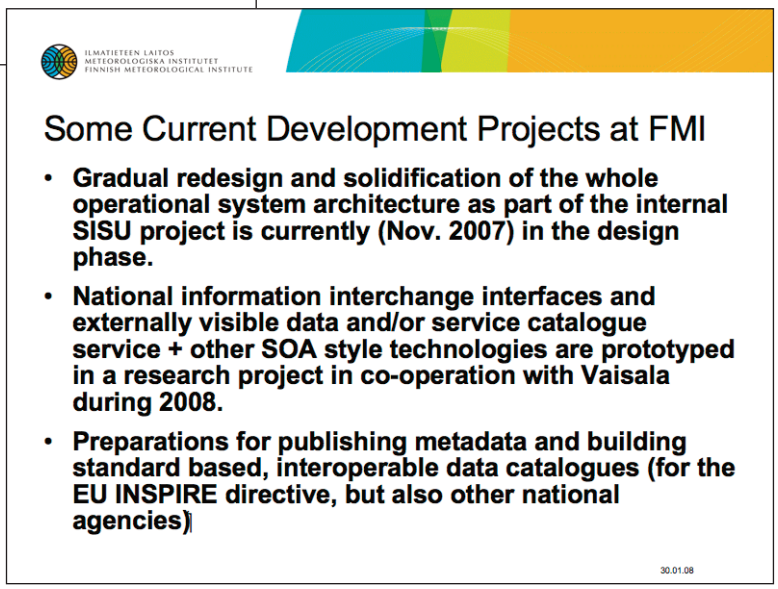
Because of the vast amount of the possibly involved data and the fast throughput requirements of the whole production chain, it is not feasible to transfer and store all the data in centrally in a single data repository. The Distributed data repository strategy creates a challenge for the data cataloging and availability services however.

The OGC Catalog Service and especially its web service oriented flavour Web Registry Service is a promising technology for maintaing a centralized, up-to-dat registry for different service components available in a distributed system implemented using Service Oriented Architexture (SOA) over an HTTP-connected, heterogenious network. Transferring large pieces of data from an processing chain member to another using HTTP is however costly.

In a meteorological operational system with data intensive processing chains and, on the other hand, a common technological infrastructure, a more efficient approach would be feasible. An Enterprise Service Bus (ESB) to transferring the data queries and responses with only references to the required large data sets stored in a shared file system, could provide a solid backbone for a service oriented operational meteorological system. ESB also makes it easier to monitor and control a distributed system as all the status messages between the different components are routed through the same channel, the bus.

This presentation summarizes the current plans and ideas considering data discovery and availability strategies and implementing service oriented operational system at FMI.





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Data Availability Services?

- **How to find the data that *should* be stored somewhere?**
  - Or know for sure, that we don't have it?
    - If so, how to get it from somewhere else on demand?
- **How to define and gather the necessary metadata for all the incoming and self-produced meteorological information?**
  - Standard metadata description languages for meteorological data would be nice to make national and international information interchange easier
- **How to establish a minimal but sufficient set of data transfer methods and data formats?**

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Data Availability Knowledge Is Essential

- **Need to take full advantage of the improving resolution of the numerical forecast and nowcasting data in the highly customized end-user products**
  - No time to generate products that are not needed right now. Instead do more on-demand processing
- **For on-demand production to be efficient and produce up-to-date products, good and fast data availability services are needed.**
- **The machines alone cannot do the forecasting well enough: The meteorologists make operative decisions in selecting and correcting the data based on multiple data sources and their expertise.**
  - Need to find relevant comparison data efficiently

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Challenges In The Current Operational System

- **Different query interfaces to the different data storages**
  - SQL, C++ API, direct file-system browsing, own in-house query languages,...
- **For some data, scanning file system directories is the only way to find out if the data for certain time is available or not.**
- **The same data might be scattered around the system in different formats.**
- **No audit trails for the production chains from the raw data arrival to the delivered customer products.**

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Use Service Oriented Architecture Internally

- **Many different internal data providers, but one central Service Registry**
  - What kind of data is offered by which provider?
  - How can the queries for available metadata be filtered upon a query?
  - In which formats and packages can the data be retrieved?
- **Each data provider is responsible for**
  - storing the data,
  - gathering the necessary metadata, and
  - providing the query interface for the available data.

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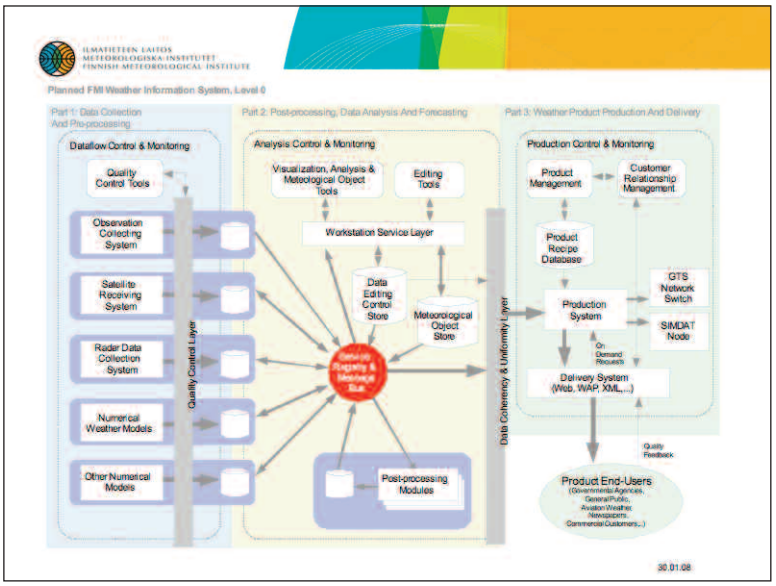

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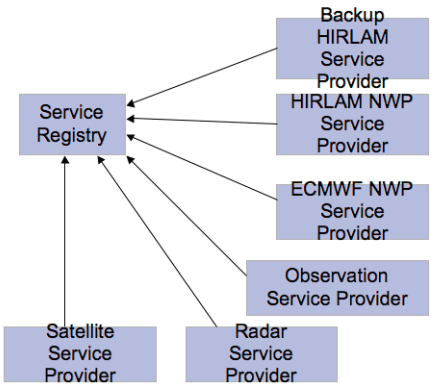
The "SOA Inside" Scenario



Data & Service Providers register their services to the registry when becoming on-line and going off-line.

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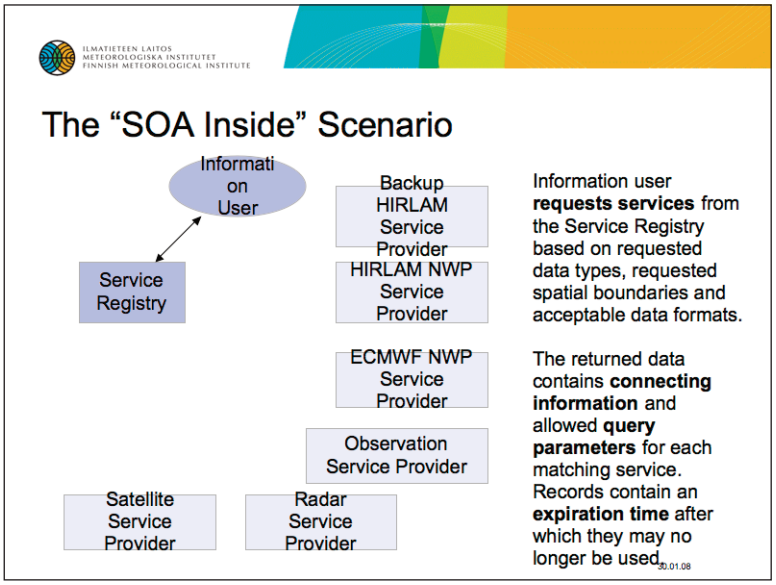
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The "SOA Inside" Scenario
Informati on User
Service Registry
Backup HIRLAM Service Provider
HIRLAM NWP Service Provider
ECMWF NWP Service Provider
Observation Service Provider
Satellite Service Provider
Radar Service Provider
Information user requests services from the Service Registry based on requested data types, requested spatial boundaries and acceptable data formats.
The returned data contains connecting information and allowed query parameters for each matching service. Records contain an expiration time after which they may no longer be used.
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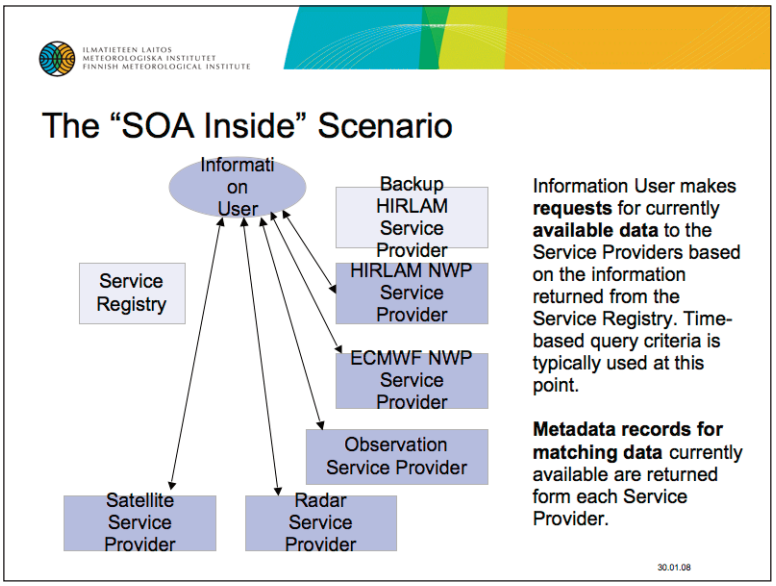
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Service Registry
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Information User makes requests for currently available data to the Service Providers based on the information returned from the Service Registry. Time-based query criteria is typically used at this point.
Metadata records for matching data currently available are returned form each Service Provider.
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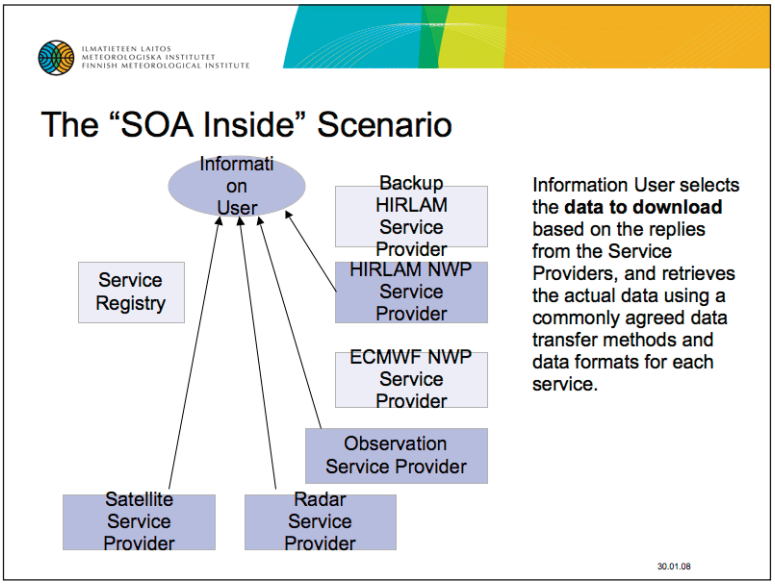
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HIRLAM NWP Service Provider
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Information User selects the data to download based on the replies from the Service Providers, and retrieves the actual data using a commonly agreed data transfer methods and data formats for each service.
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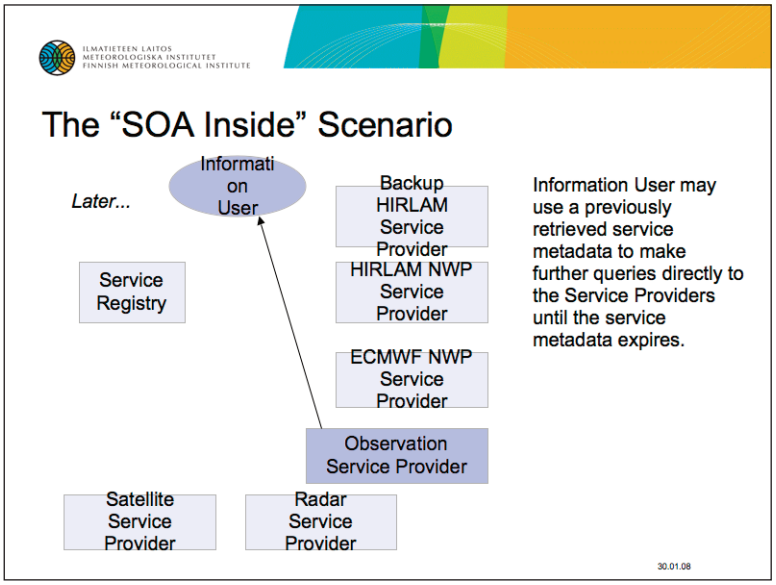
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HIRLAM NWP Service Provider
Service Registry
ECMWF NWP Service Provider
Observation Service Provider
Satellite Service Provider
Radar Service Provider
Information User may use a previously retrieved service metadata to make further queries directly to the Service Providers until the service metadata expires.
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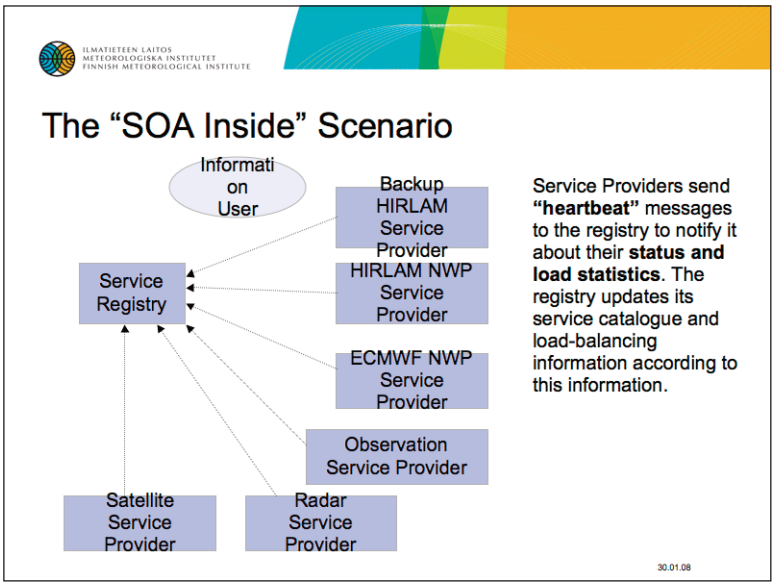
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Service Providers send "heartbeat" messages to the registry to notify it about their status and load statistics. The registry updates its service catalogue and load-balancing information according to this information.
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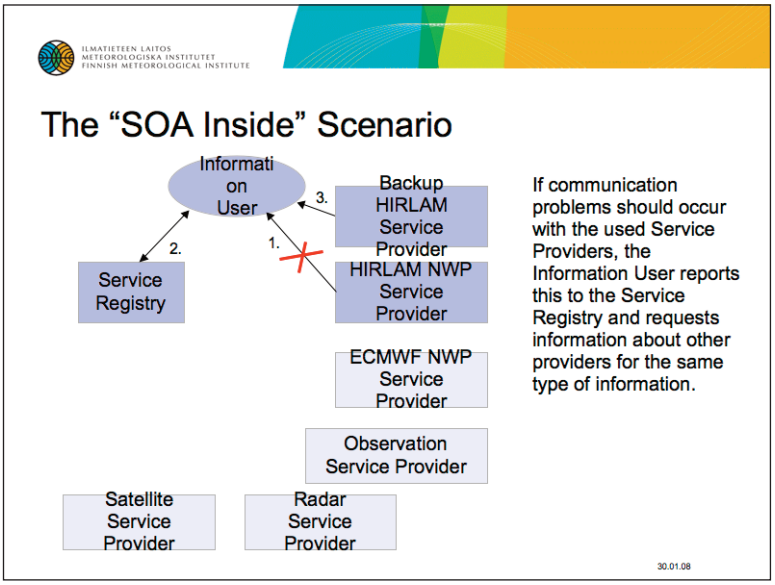
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3.
Backup HIRLAM Service Provider
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Service Registry
HIRLAM NWP Service Provider
ECMWF NWP Service Provider
Observation Service Provider
Satellite Service Provider
Radar Service Provider
If communication problems should occur with the used Service Providers, the Information User reports this to the Service Registry and requests information about other providers for the same type of information.
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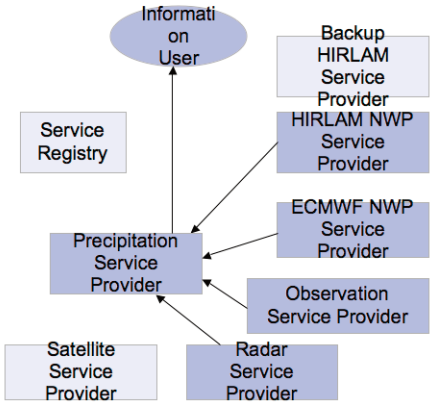
The "SOA Inside" Scenario



A post-processing systems act both as Information Users for the required input data and Service Providers for their specific output data.

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"Standard" Catalogues And Registries

- **Generally a catalogue is an open and well defined collection of GML application schemas, phenomena directories, controlled vocabularies, service bindings etc.**
  - A common place for discovering data-centric services and their communication interfaces
  - Registry = governed catalogue
  - A key enabler in data and services interoperability
- **OpenGIS Catalogue Services Specification**
  - Abstract and generic
  - HTTP binding = Catalogue Service for Web (CSW)
  - IIOP/CORBA binding is also specified

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"Standard" Catalogues And Registries

- **ebXML Registry Information Model (ebRIM) used as registry model for the majority of OGC Catalogue Service implementers**
  - Specifies how the metadata is organized in the registry
  - OGC prefers this registry information model over for example a more general UDDI
- **Question: Is the CSW/ebRIM fast enough (and not too complex) for our internal use?**
  - 100 msecs is a much longer time within the operational production system than in web browsing.

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Internal Catalogue Service Implementation

- **Use the "standard" catalogue information model and metadata languages**
  - Provide a common language for international information interchange
  - No use inventing the wheel once again
- **But the implementation of the internal catalogue service interface need not to a web service (that is HTTP) based:**
  - Message Orientation would be interesting: asynchronous data availability queries, status notifications and loose coupling between the system components would introduce a lot of flexibility
  - Better quality of service and less overhead than HTTP

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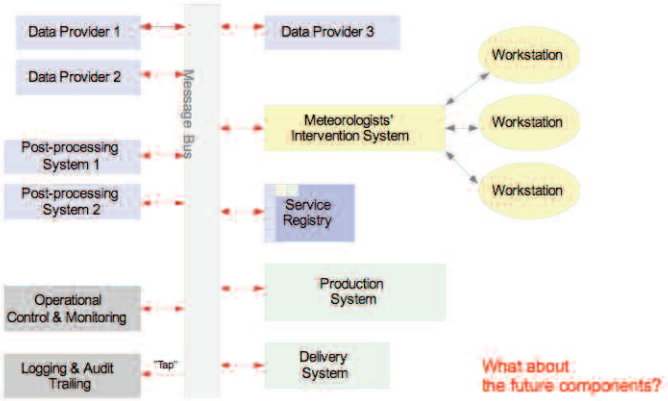
Message Oriented Data Availability?



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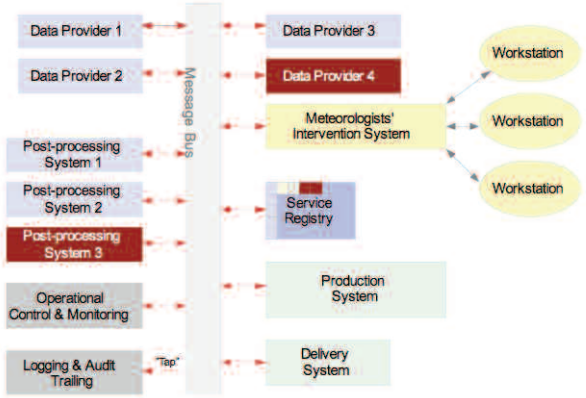

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Don't Block The Road

- **Transferring large datasets over a common messaging bus is probably not a good idea**
  - Relatively small messages make things much easier for the message bus, which needs to be as simple and reliable as possible.
- **Why copy the bulky data files over the network if we could read them directly using a shared file system?**
  - Tracing and limiting the access could be a problem
- **If the physical data transfer is needed, use existing efficient data transfer mechanisms**
  - FTP, rsync, you name it.

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Conclusions

- **The importance of efficient data availability services will grow rapidly in the near future.**
- **The need for standardized meteorological metadata, data catalogue service interfaces and catalogue implementations is obvious**
- **Adhering to the standard repository information models and data description languages also internally makes the future integration easier**
- **Standing on the shoulders of giants: We should bring all the expertise used in making the standards into a proper use.**
- **Message orientation could provide a solid backbone for the next generation met. operational system**

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