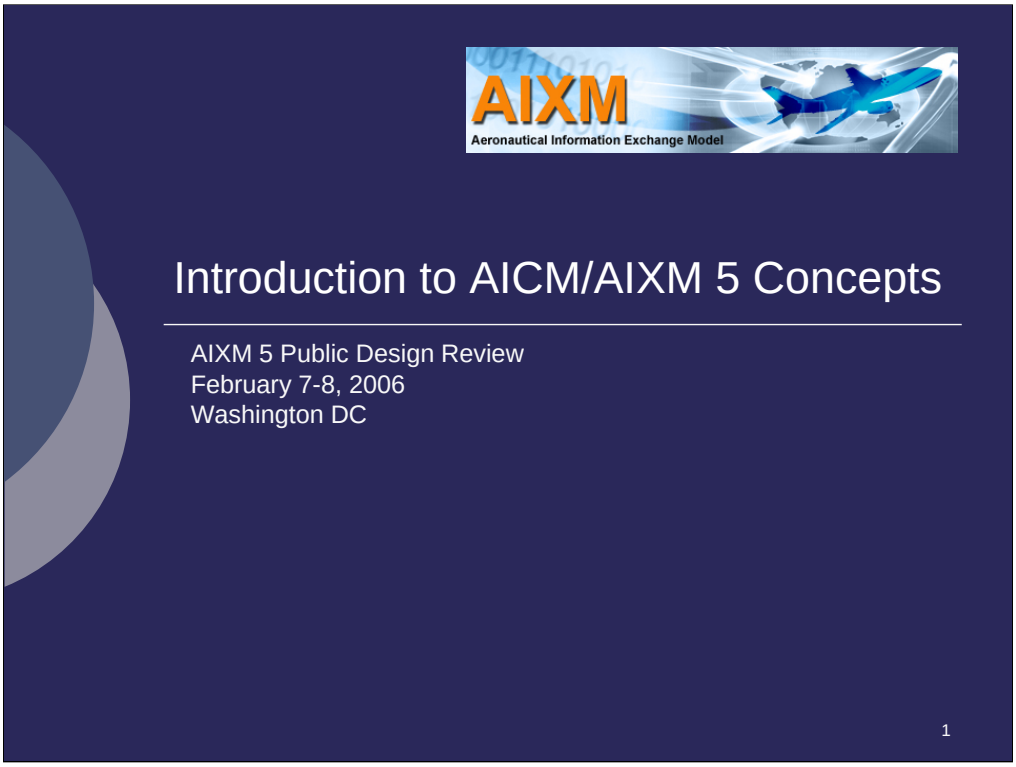
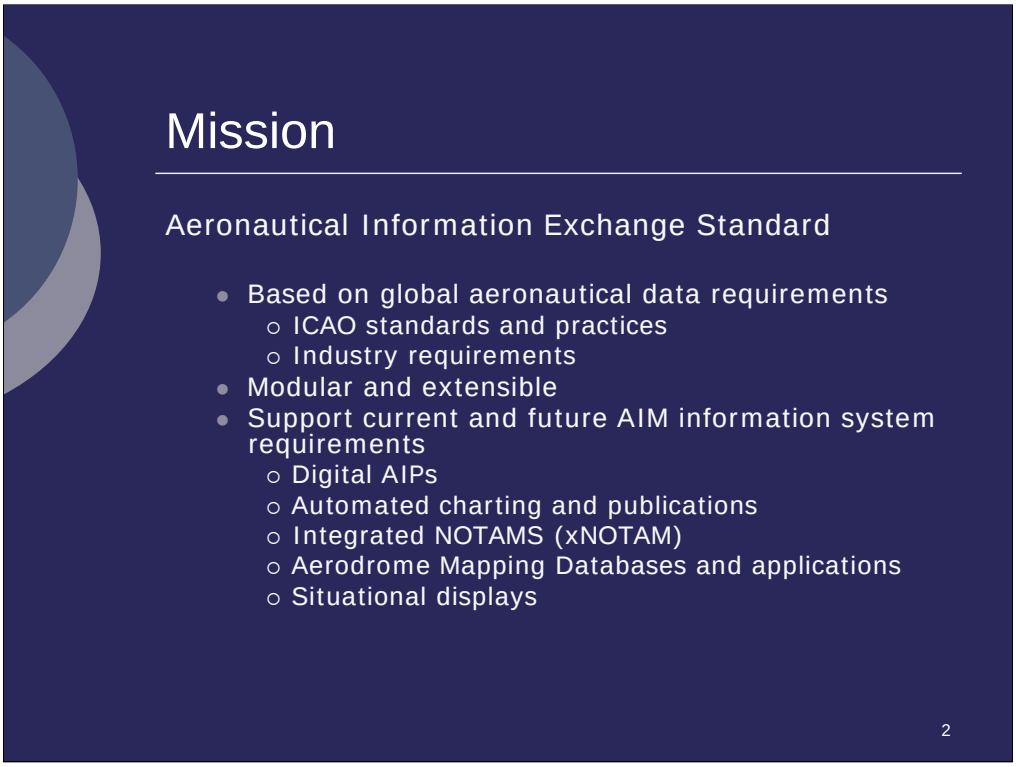


The use case presentation has revealed just a few of the new applications and services that could be developed on the foundation offered by an internationally agreed aeronautical information exchange specification. These services range from 'classical' automation, such as database driven charting, to new possibilities, such as updating on-board situation awareness systems with the latest NOTAM in force. Let's see now which are the main elements that position AIXM version 5 as ***the candidate*** for becoming this internationally agreed aeronautical data exchange standard.

This presentation is based on the first part of the "AICM and AIXM 5 - Exchange Model goals, requirements and design" document.



The goal for AIXM 5 is to provide an extensible, modular aeronautical information exchange standard that can be used to satisfy information exchange requirements for current and future aeronautical information applications. These applications include:

- Automated production of Aeronautical Information Publications (AIPs)
- Automated aeronautical chart creation and publication systems
- Integrated NOTAMs (e.g., xNOTAM)
- Aerodrome Mapping Databases (AMDBs) and related applications
- Electronic Flight Bag data requirements
- Cockpit situational displays and Flight Management System (FMS) data requirements

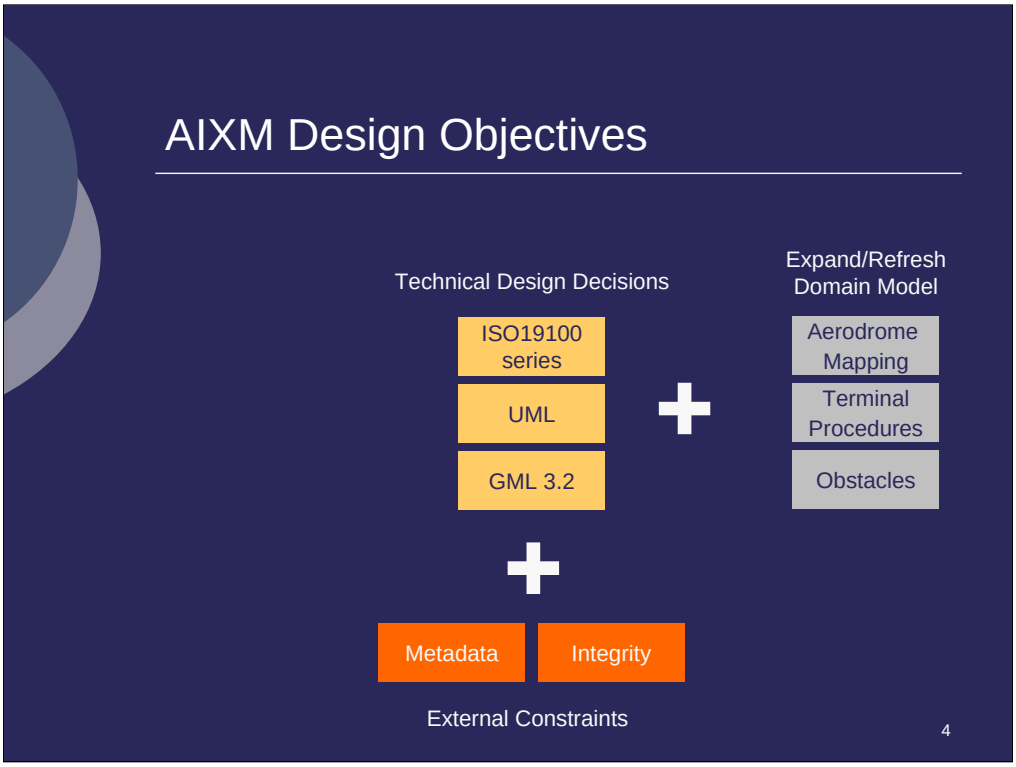
With this mission in mind, a number of design objectives have been identified.

First, a number of technical design decisions: adoption of a number of international standards that would maximize the chances for interoperability (not only within the aeronautical domain but also with other transportation industries) while also reducing the implementation costs, by enabling the use of Commercial Off The Shelf (COTS) software:

- Use GML (Geography Markup Language) for encoding geographical information – positions, areas, routes, etc.
  - As opposed to the custom geometry encodings used in the current AIXM 4.5
- Use the ISO19100 series of geospatial information standards as data modelling framework
  - This would maximize the chances of cross-domain interoperability
- Use UML (Unified Modeling Language) for developing AICM 5

Closely linked to the ISO 19100 modelling framework, the requirement for exhaustive metadata incorporation into the model has been identified. Metadata is in fact closely linked to a stringent requirement, as highlighted in the previous presentations: the need to endure data integrity from end to end of the data chain.

Let’s see now how the scope of the model will evolve.

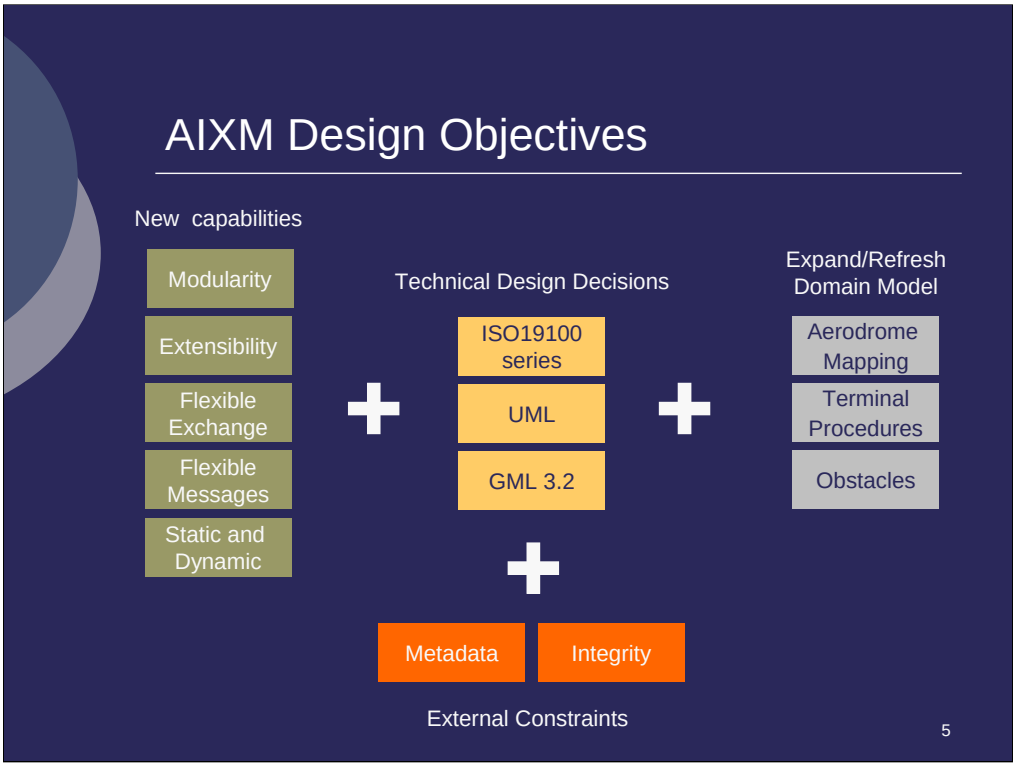


The world of aeronautical information is in continuous evolution and in the last few years this is happening with increasing speed. Not only that the scope of the domain has expanded, but also well established concepts face new requirements. This is particularly the case with:

•Obstacle information – where States are required by ICAO to make available (by 2008) obstacle databases, following a number of strict criteria for data quality; (terrain is another such requirements, but for the moment it is considered outside the scope of the model; terrain information is not subject to the same update cycles and distribution channels as the rest of the aeronautical information)

•Data publication requirements for SID/STAR/IAP procedures have been radically modified by the introduction of area navigation (RNAV) and especially by the GNSS based navigation; just as an example, the concept of Terminal Arrival Altitudes (TAA) has been introduced.

•Aerodrome mapping – data publication requirements are the result of a joint activity of RTCA and EUROCAE. The aim of AIXM 5 is to support temporary change notifications for the objects that have an impact on international air navigation; airport maps – cockpit situational displays – need to be supported; therefore, the features identified in the Industry Requirements for Airport Mapping Data will be supported in AIXM 5.

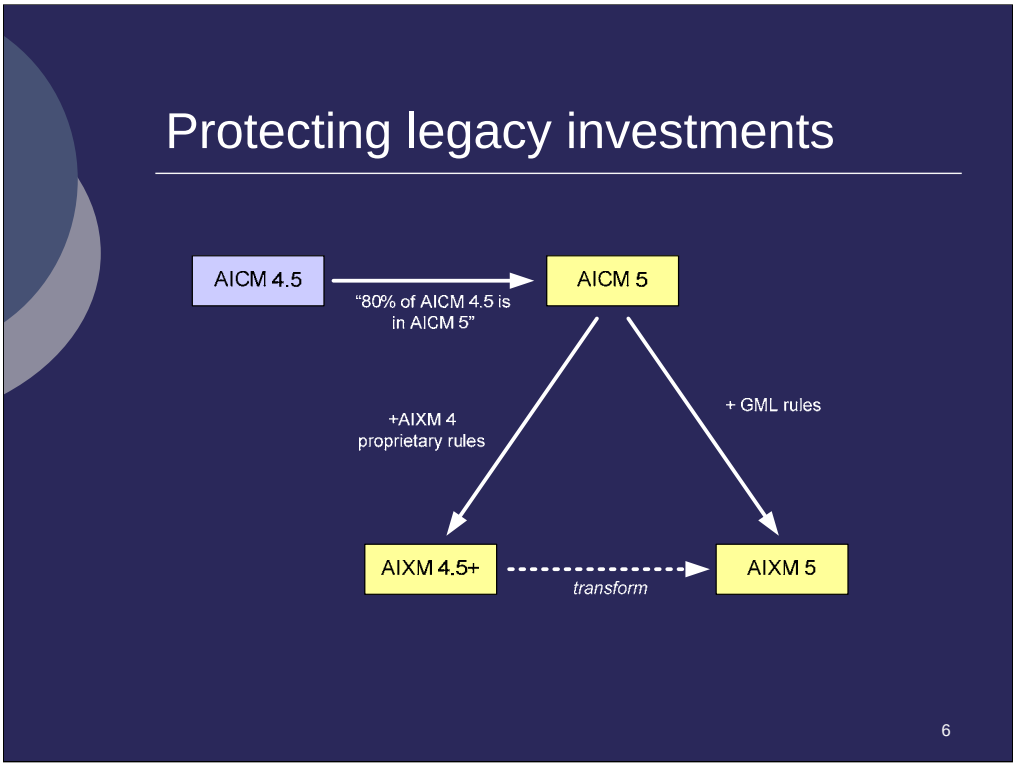


Finally, a number of a new capabilities for the data exchange specification itself:

•First and most important – equal coverage for static and dynamic data; be able to communicate both 'permanent' changes, such as those that occur at AIRAC cycles and temporary situations, typically promulgated through NOTAM; this requires the introduction of an exhaustive temporality concept in the model; it will be the subject of detailed presentations during this Design Review Meeting

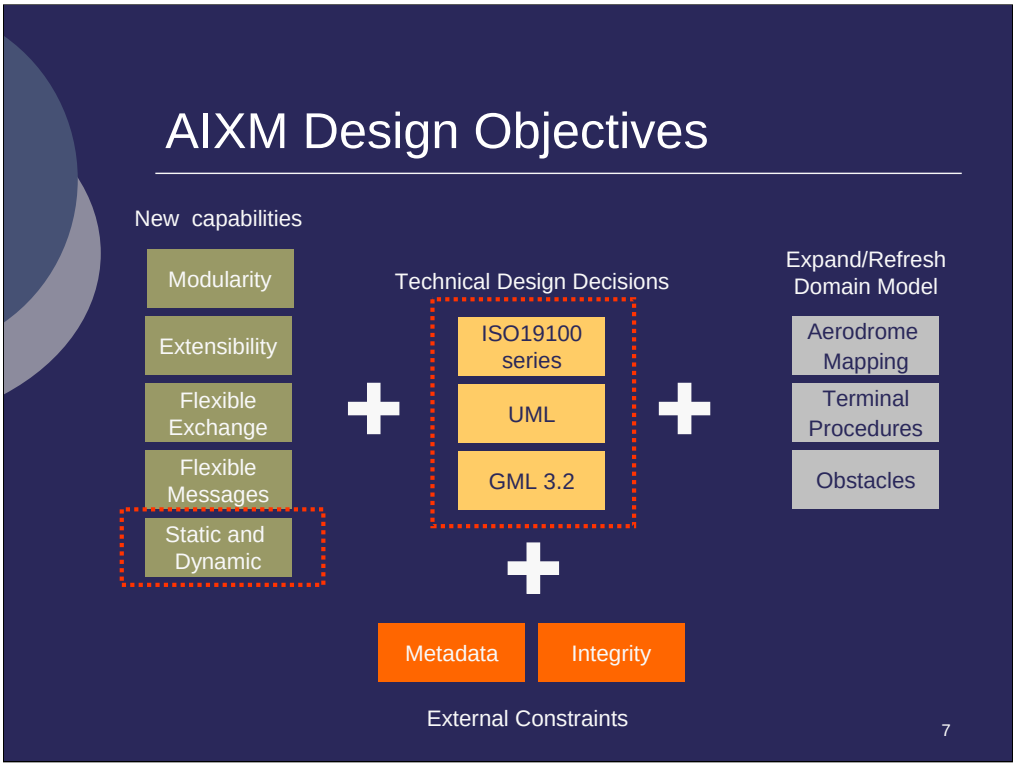
•Second, modularity and extensibility: offer the possibility to easily re-use a part of the exchange specification for a particular domain, which might be interested only by a limited number of features without dealing with the complexity of the whole AIXM; offer the possibility for third parties to expand the model – additional features, additional properties or domain values – for local application; the experience with the AIXM change requests in the last two version (4.0 and 4.5) have shown how necessary this is; almost every application has some concepts of local interest that need a standard way to entry in the model without affecting the global interoperability. Place names in local language are a typical example.

•Third – flexibility of messages and exchange scenarios: the current model is limited to two standard messages: Snapshot and Update – which have been proven insufficient for a range of applications. User communities and applications should have the possibility to decide on the types of messages that they want to compose using the AIXM pool of features and also on the scenarios in which these messages are used. The 'navaid' application example, which will be presented this afternoon, will demonstrate this aspect.

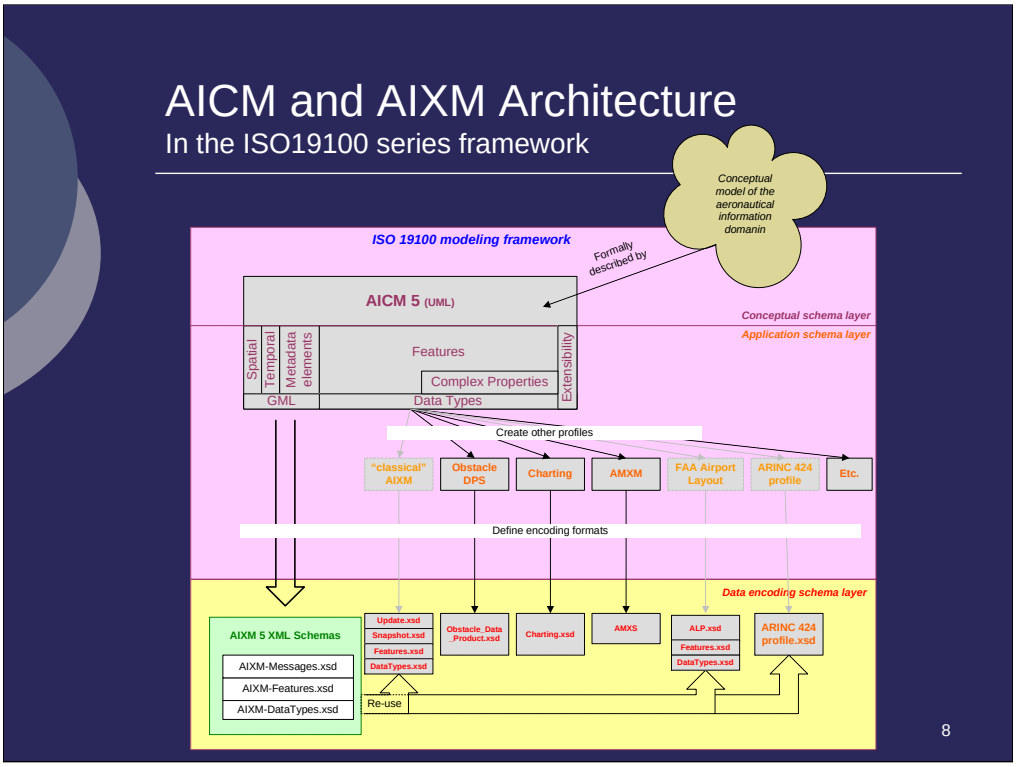


While making these improvements to AIXM, we are mindful of legacy investments in earlier AIXM releases. It is important that we provide a clear path for migrating systems. Our approach is to support legacy AIXM 4.x and AIXM 5 from the same conceptual model.

This is possible because "80% of AICM 4.5 is AICM 5" We believe that the AICM 5 data model changes can be accommodated with both the AICM 4.x environment and the new AICM 5 environment. From AICM 5 we can derive AIXM 4.5+ using AIXM 4 proprietary implementation rules and for AIXM 5 we can use GML rules to encode an AIXM GML application schema. We believe it will be possible to demonstrate that transformations can be used to convert legacy AIXM 4.5+ into AIXM 5.



Coming back to the high level design objectives, the next few slides will give a few more details about the ISO 19100 modelling framework, use of UML and GML. Also, a few words about the temporal concepts for AIXM 5.



This diagram is the first attempt to put puts our design principles together within the ISO 19100 modeling framework.

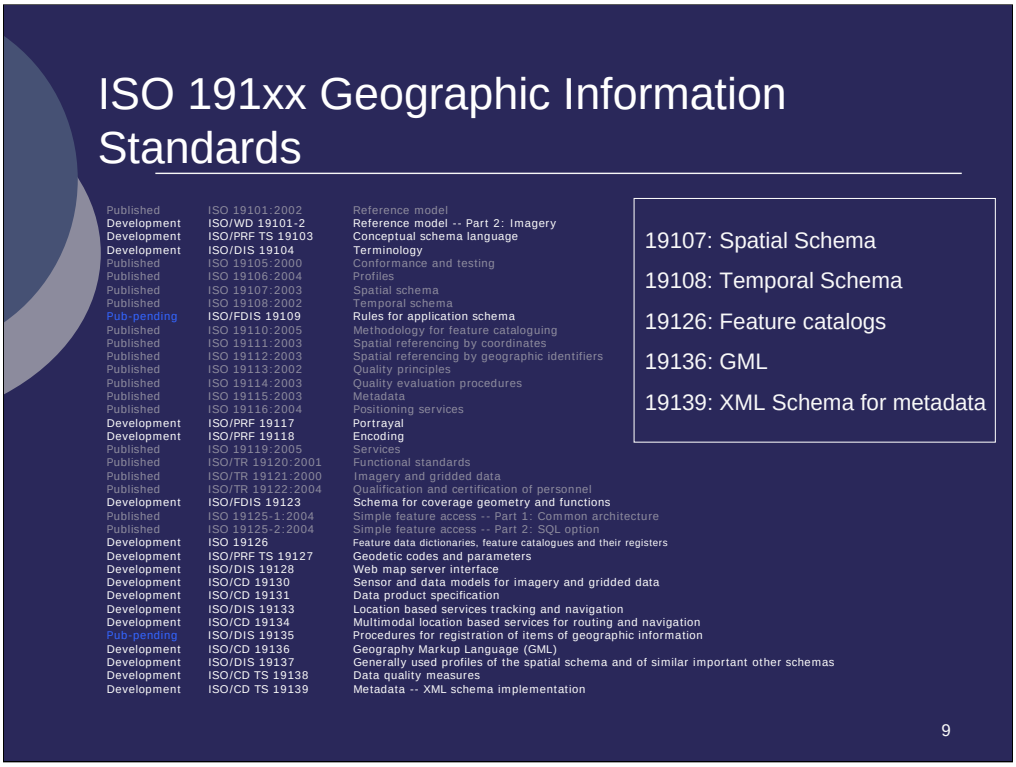
Why are ISO standards so important? Because ISO standards provide a well-thought out foundation for building geographical data exchange specification, that can be applied to AICM/AIXM. The ISO standards includes internationally accepted models for temporality, geometry and meta-data that should be included in AICM. Basically the ISO 19100 series has three layers:

•General feature model framework for building a conceptual schema that represents in a formal way the universe of discourse

•Application schema specification – A conceptual schema that defines how a universe of discourse shall be described as data is called an application schema; this level gives the possibility to re-use the already defined ISO concepts for temporality, geometry, metadata, etc.

•Data encoding specification – which is our final objective. This will provide the AIXM 5 XML Schema modules that containing XML representations of the features, properties and messages and can be used to build custom system to system interchange messages

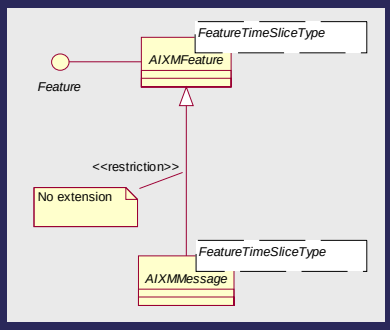
However, please keep in mind that this is our draft view, which will need to be reviewed and consolidated.



The ISO 19100 series includes a series of standards that are published and in development. Some of the important ones are listed in the box to the right.

UML
Unified Modeling Language

- Visual language for capturing relationships, behavior and high-level ideas
- Originally intended for Software Engineering
- Today also used for
  - Business process modeling
  - Data modeling
  - Requirements modeling
  - Others…



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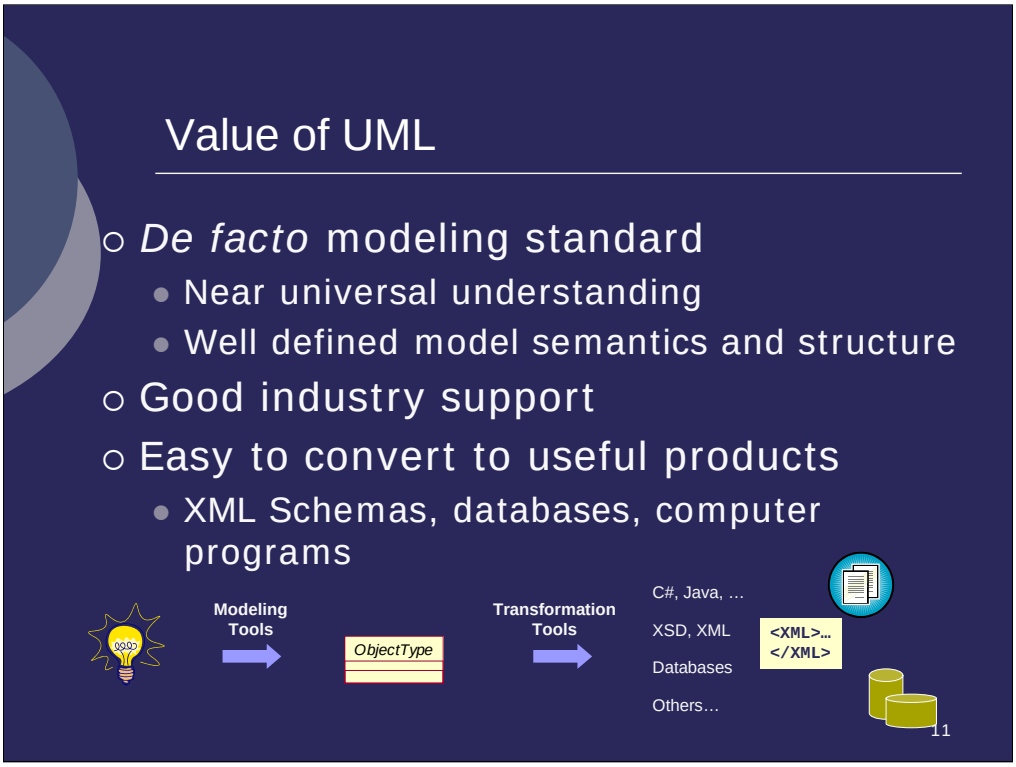
UML stands for the Unified Modeling Language. It is visual language for describing relationships, behavior and high level ideas. It was originally intended for software engineering, but today UML is used for business process modeling, data modeling, requirements modeling and other activities.



UML offers a number of advantages as a modeling language. It is the de facto modeling standard with a well defined model structure and semantics. It has good industry support in the form of UML modeling tools and tools that can convert UML into useful products like XML schemas, databases and computer programs.

What is GML?

- Internationally agreed format for geographical features encoding
  - Based on XML Schema
  - Open GIS Consortium
    - Future ISO standards

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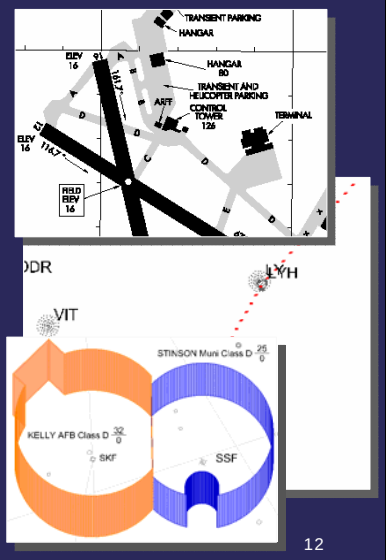
- Good industry adoption by Geographic Information System (GIS) vendors
  - Commercial Off the Shelf Software



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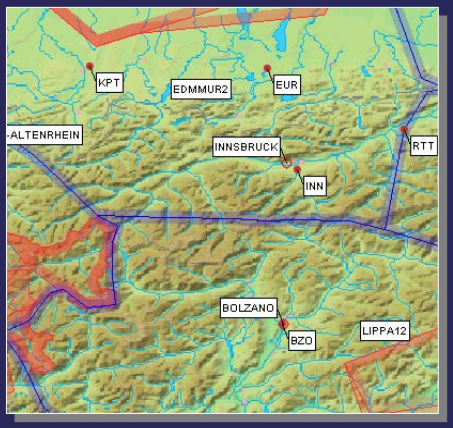
GML simplifies GIS (Geographic Information Systems) because industry tools understand it. This contrasts with current AIXM (developed in the years preceding the apparition of GML) where geometries are encoded using a custom XML schema. Custom computer code is required to understand and draw geometries encoded in AIXM 4. By using GML, we can leverage commercial software that can already understand GML.

Realizing the power of GML

- Example: Eurocontrol SkyView Tool
  - Prototype
- Seamless GML view using WMS/WFS
  - Topography
  - Airspace
  - Weather
  - Flight plans

+GML

Aero domain model
+ standardized visualization!



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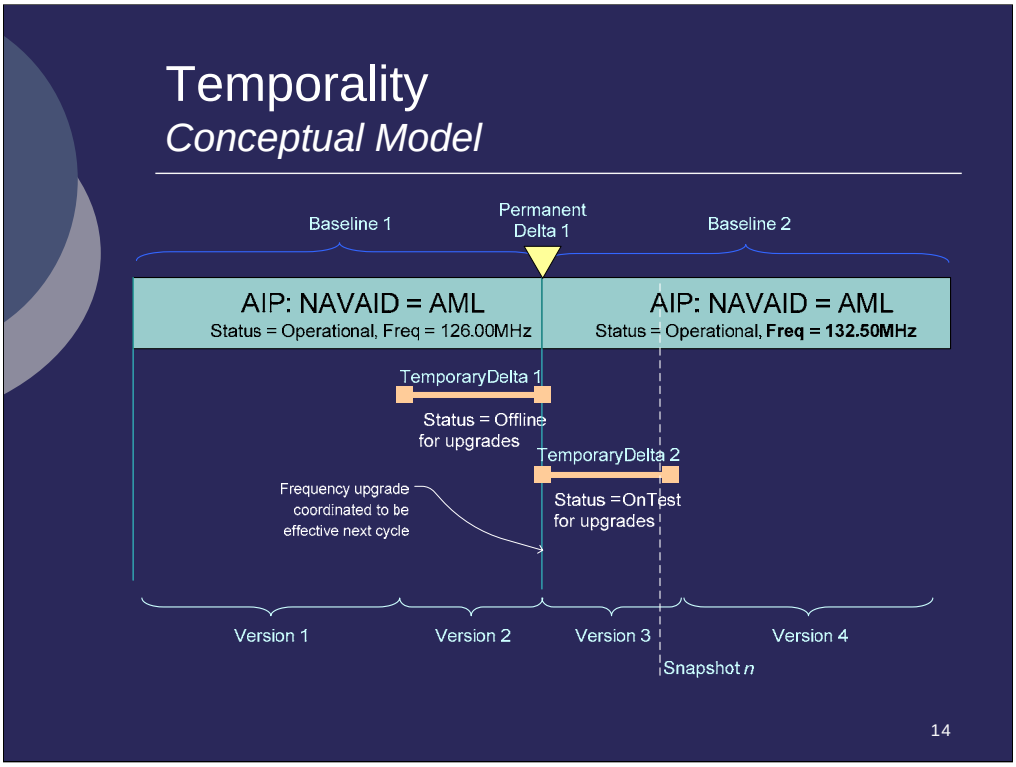
The power of GML is that it allows us to leverage existing commercial tools and existing GML data sources to create a seamless GIS view. This picture shows a snapshot from EUROCONTROL's SkyView tool. Skyview can read and display GML from a variety of data sources. Simply by understanding GML, SkyView can display terrain, airspace boundaries, fixes and airport.



There are two levels at which aeronautical feature instances are affected by time:

- Every feature has a start of life and end of life
- The properties of a feature or the target of any feature relationship can change within the lifetime of the feature
    - these can be classified as temporary or permanent based on the need to support current AIM concepts of operation. For example permanent changes may be captured as AIRAC amendments and included on paper charts and publications. Temporary changes are typically NOTAM

In order to present our temporal view, we have developed the following terminology:

Baseline – The state of a feature and all of the feature properties as a result of a permanent change. The Baseline state of a feature also exists when the feature is initially created. The baseline state lasts until the next permanent change.

Version – The state of a feature and all the feature properties during the time period between two changes.

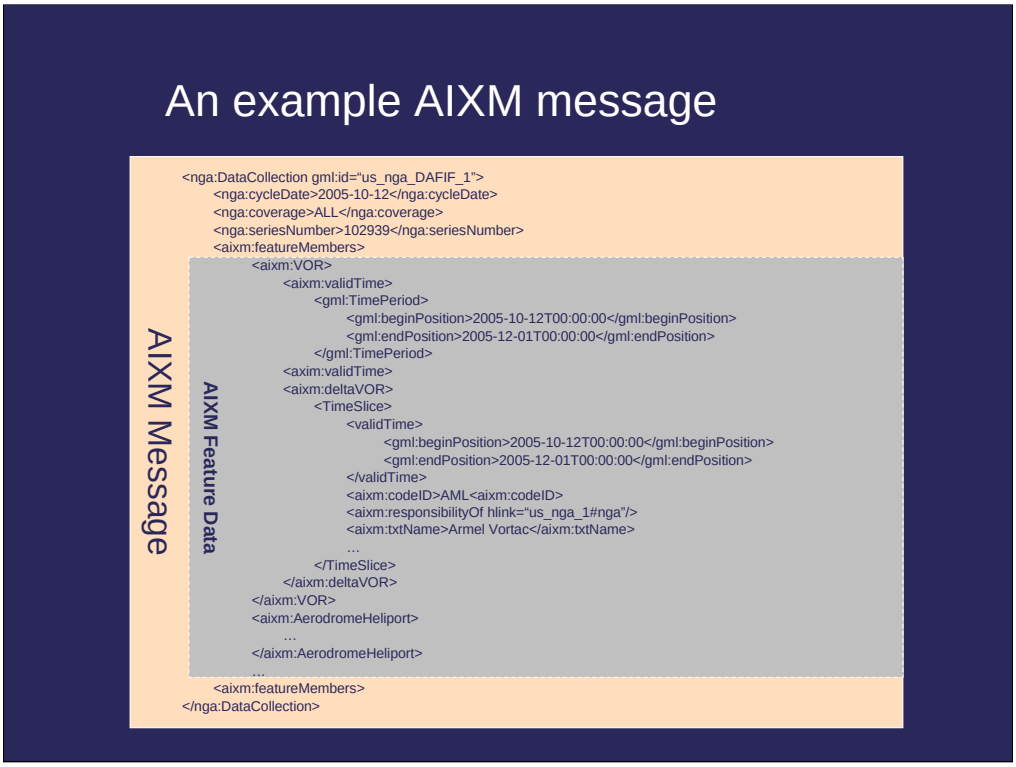
Permanent Delta – A set of properties that have changed or will change permanently. The permanent delta will result in a new baseline.

Temporary Delta – A set of values for one or more feature properties that are effective for a limited time. The result is a temporary change to an underlying feature version.

Snapshot – Feature state at a time instant. The snapshot is the result of a combination of feature versions and any deltas that are active at the time instant.

The diagram illustrates the temporal model by showing changes to a navigation aid between one AIRAC cycle to the next. In this example, NAVAID AML has a frequency change from 126.00 MHz to 132.5 MHz between two AIRAC update cycles. Changes in the operational status of the AML NAVAID during the frequency upgrade lead to two NOTAM.

An example AIXM message



Just as an example, the draft XML encoding is provided here of a potential AIXM 5 message. The presentation of this afternoon will go in far more details about this example.

This concludes the high level presentation of the AIXM 5 Design Concepts. The last two slides contain some information about the agenda of the next 1.5 days and the tentative AIXM 5 publication calendar.

Next on the Agenda

This afternoon

- AIXM 5 Design Concepts Details & Examples

Tomorrow

- Domain Model Review (from AICM 4.5 to 5)
- Requirements analysis
  - New obstacle model
  - New terminal procedures model
- Summary and next steps

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Calendar

Feb - Mar 2006

AIXM 5 Public Comment Period

Jun 2006 - AIXM 5 Draft release

Jun - Sep 2006

AIXM 5 Second public comment period

Nov 2006 - AIXM 5 Proposed Release

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