

TAS



Traffic Management Initiative (TMI) Ontology

Semantic Web for Air Transportation (SWAT) Interest Group Meeting
August 24, 2015

Agenda

- Project Sponsorship
- Project Motivation
- Project Objectives
- TMI Ontology
 - Analyzing and Documenting TMI data
 - Development of the Ontology
 - Ontology Details
 - Application of the Ontology

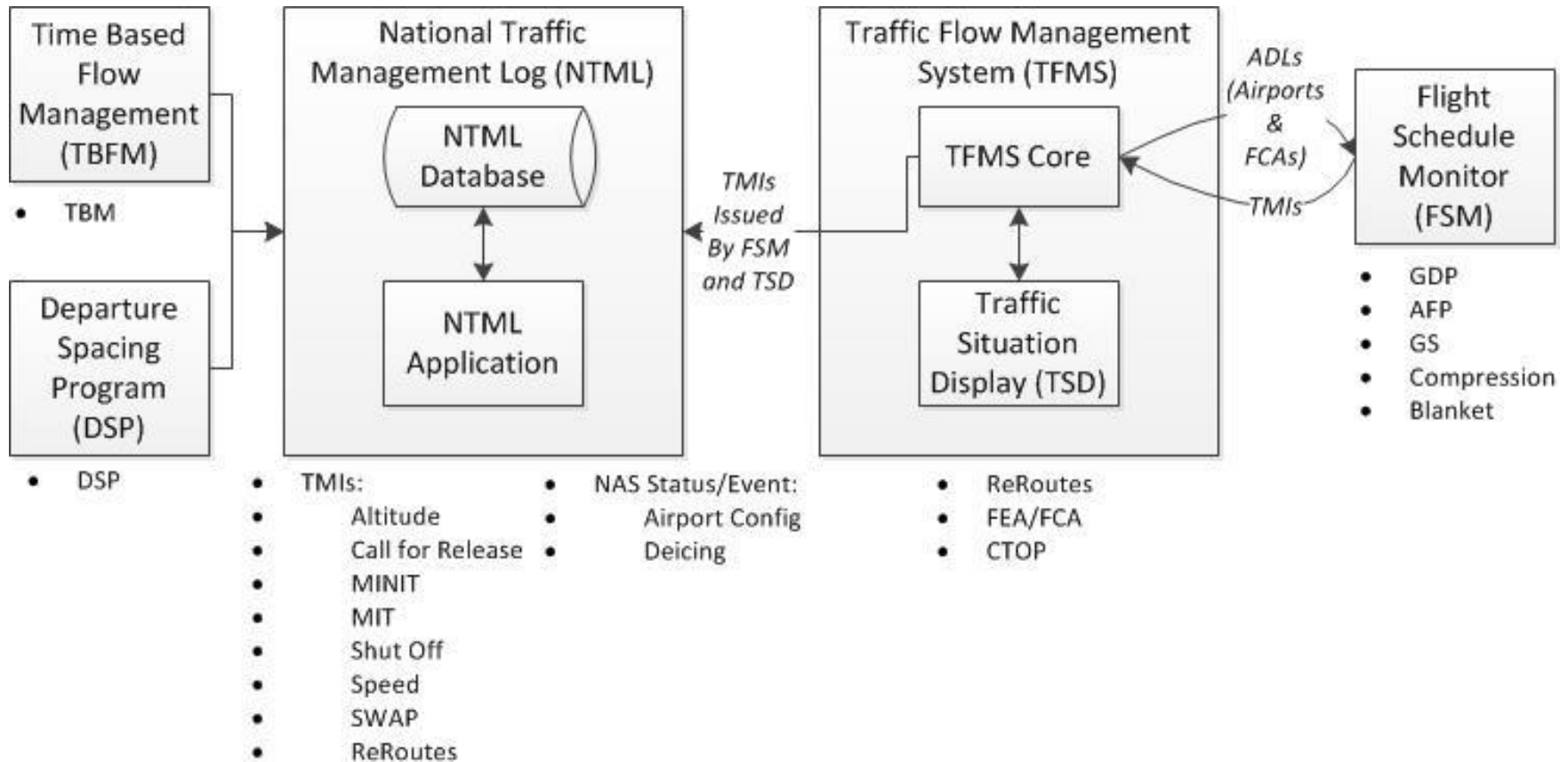
Project Sponsorship



- FAA Office of NextGen
 - NextGen Portfolio Management & Technology Development
 - TMI Attribute Standardization (TAS) Project
 - Kevin Hatton – Project Lead

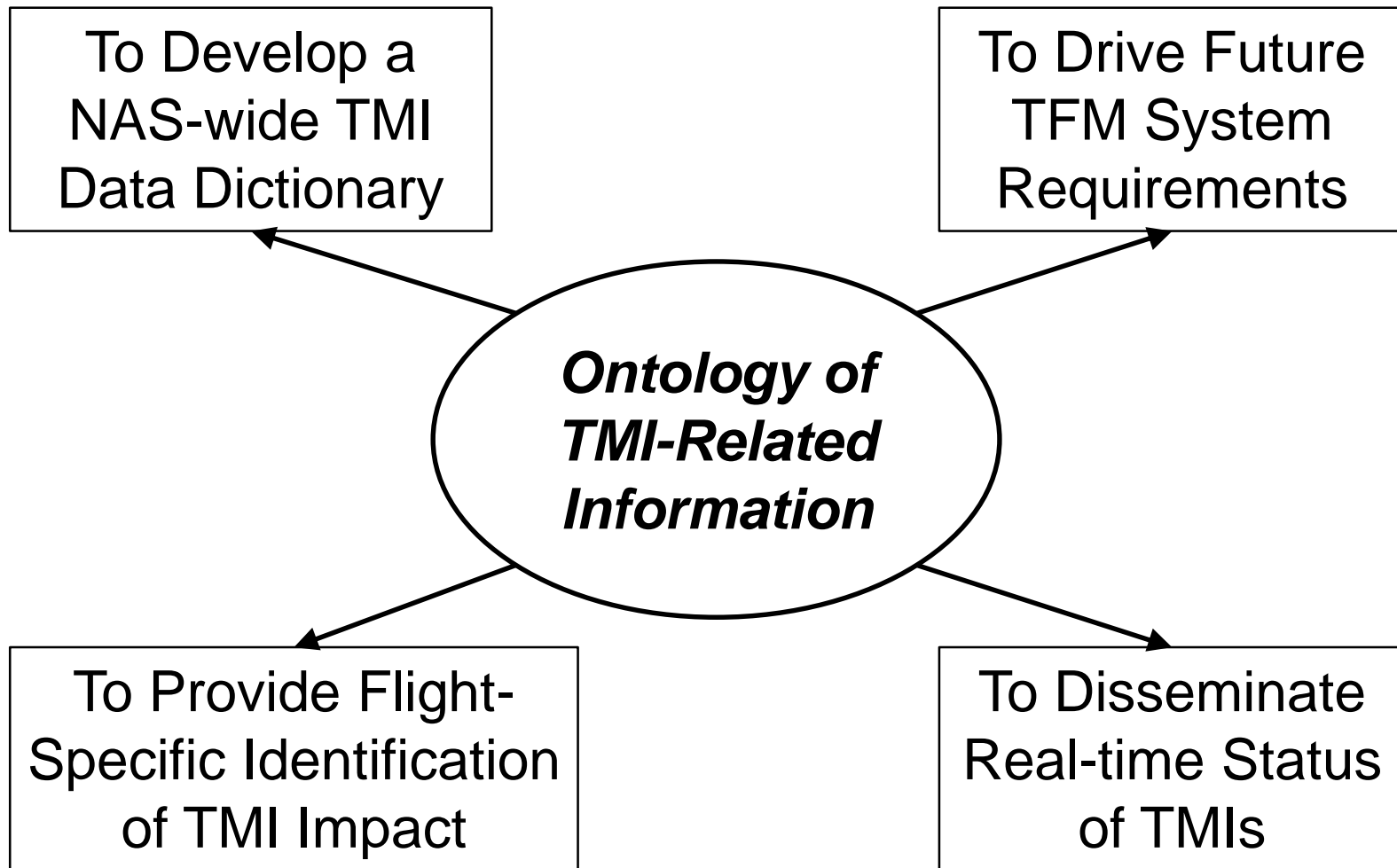
Project Motivation

- In today's NAS, traffic managers issue and/or enter TMI information through multiple systems



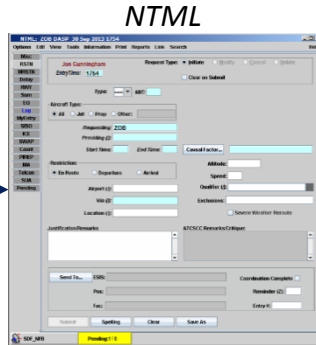
- **Common situational awareness** of all restrictions/TMIs has improved in the last decade with NTML, but is still problematic
- Existing systems have been developed without an **overarching structure for TMI data elements**
- **Free text entries** provide flexibility, but can also be problematic, creating **ambiguity** for TMI tool users and post-event analysts
- Identification of **which flights are affected** by each TMI, and how, vary significantly across tools/TMI types
- Vast potential to improve daily NAS operations by **analyzing recorded TMI data**, but not all required data is captured

Project Objectives



TMI Data Analysis

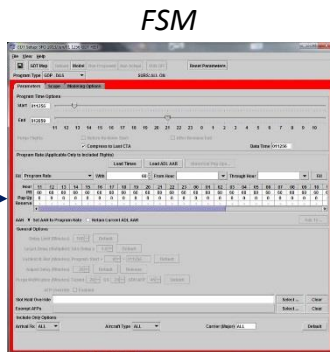
ALT
APREQ
DSP
MIT
MINIT
Reroute
SPD
Shut Off
SWAP
TBM



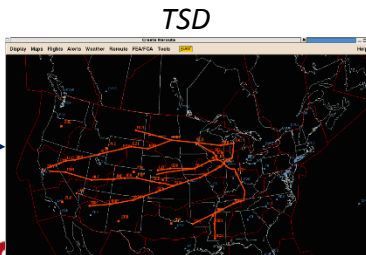
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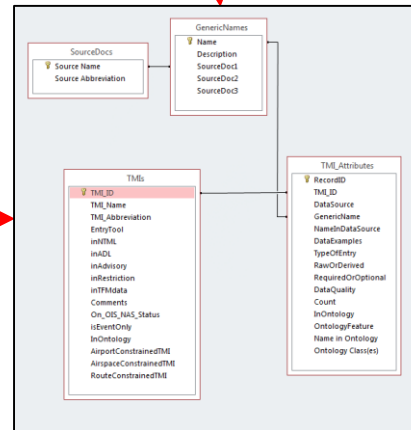
AFP
BLKT
COMP
GDP
GS



CTOP
Reroute
FEA/FCA



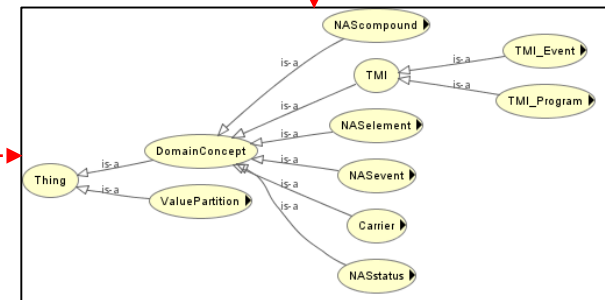
TMI Database



Other Sources of Information:

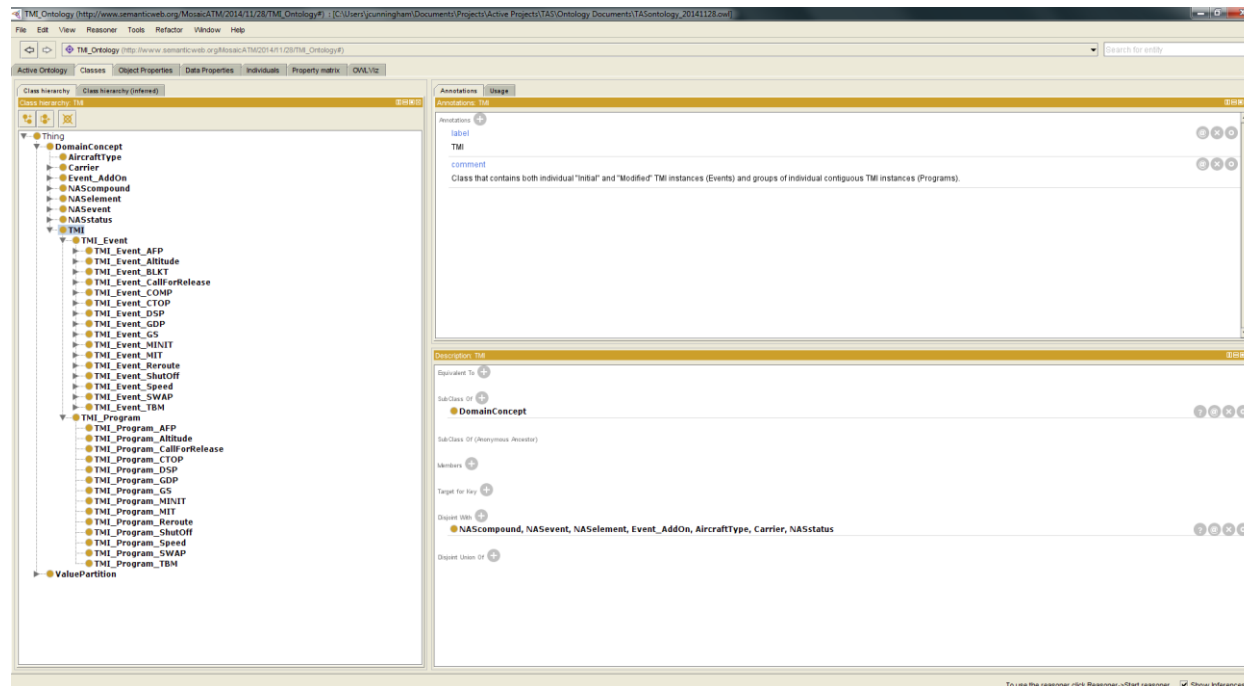
- TAS Workshop on Nov. 13-14, 2013
- Site visits to ZJX, ZNY, ZDV, D01, and ATCSCC
- Team domain knowledge

TMI Ontology



Ontology Development

- Development was conducted using Protégé 4, which is a free, open-source ontology editor
- Protégé ontologies are saved in the OWL 2 Web Ontology Language file format as specified by the World Wide Web Consortium (W3C).



TMI Ontology Scope

Fully Modeled

TMI
Airspace Flow Program
Altitude Restriction
Blanket Adjustment
Call for Release (APREQ)
Collaborative Trajectory Options Program
Compression
Departure Sequencing Program
Ground Delay Program
Ground Stop
Miles-In-Trail
Minutes-In-Trail
Reroute Restriction
Severe Weather Avoidance Plan
Shut Off Traffic Flow
Speed Restriction
Time-Based Metering

NAS Event
Deicing
Flow Evaluation / Constrained Area

Event Add-On
FEA/FCA Filter
Reroute MIT

NAS Status
Airport Configuration

NAS Compound
Ad Hoc Routes

Placeholders/Links to Other Models (AIXM, FIXM, WXXM)

NAS Compound
Area
Flight Procedure
Gate
Metroplex
Route

Carrier
Major Carrier
Sub-Carrier

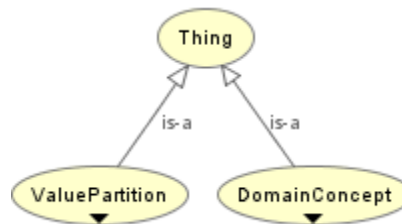
NAS Element
Airport
Airway
Center
Fix
NAVAID
Runway
Sector
Taxiway
Tower
TRACON

NAS Status
Special Use Airspace

NAS Event
Equipment Outage
Flight
Monitor Alert

Aircraft Type

- The two main super-classes in our ontology:
 - Domain Concept
 - Value Partition
- The “Domain Concept” class contains classes of individuals that represent features within the NAS or that manage the NAS
 - Example: airports, published routes, TMLs, carriers, etc.
- The “Value Partition” class contains specific classes of individuals that restrict the possible values.
 - Example: Probability of Extension, Causal Factor, Aircraft Engine Type



Domain Concept: NAS Details

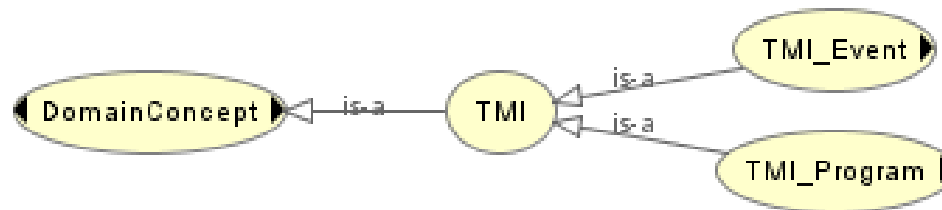


- **Aircraft type*** – class that contains individual aircraft types that currently operate in the NAS
- **Carrier*** – class that includes major and sub carriers and their connections
- **NAS elements*** – class that contains permanent locations or areas within the NAS (e.g., airport, airway, center, fix, NAVAID, runway, sector, tower, and TRACON)
- **NAS compounds*** – class that contains features that are comprised one or more NAS elements and are used to organize or manage the NAS (e.g., area, flight procedures, gate, metroplex, or route)
 - Ad hoc routes are defined in detail, including protected segments, flight filters, route types, etc.
- **NAS events** – class that contains occurrences that take place in the NAS for a finite amount of time (e.g., deicing, equipment outages, flights, flow areas, monitor alerts, and SAAs)
- **NAS status** – class that contains the state of a element within the NAS (e.g., airport configuration)
- **Event Add On** – class that describes add-ons to TMI or NAS events (e.g., reroute MIT or FEA/FCA filters)

**These classes are not defined in detail, but are placeholders for information that will be contained in another model.*

Domain Concept: TMI

- Two main classes
 - Event
 - Program
- The “Event” class contains the individual TMI instances that are issued, whether it be an “Initial” TMI or a “Modified” TMI
 - Links to only one individual in the TMI program class
- The “Program” class contains groups of individual TMI events that are issued to alleviate a specific demand/capacity imbalance
 - Links to at least one individual in the TMI event class



- Used to refine class descriptions by restricting the range of possible to an exhaustive list
- Needed for properties that have a fixed number of values that are allowed (i.e., menus)
- Examples:
 - Advisory Action: FYI, PLN, RMD, RQD
 - Aircraft Engine Type: Prop, Turbo, Jet
 - Causal Factor: Aircraft, Emergency, Volume, Weather, etc.
 - Compression Type: Slots, Flights
 - Delay Assignment Mode: DAS, GAAP, UDP
 - Request Type: Initiate, Modify, Cancel

Ontology Features

1. TMI program statistics (e.g. number of modifications/revisions)
2. Expanded TMI Event/Program concept
3. Improved TMI interaction identification
4. Ability to specify another TMI as a causal factor for passbacks
5. Identification of the flights that are impacted by TMI event
6. Qualification of aircraft other than just by engine type (e.g. equipage, category, RVSM status, user category, and weight class)

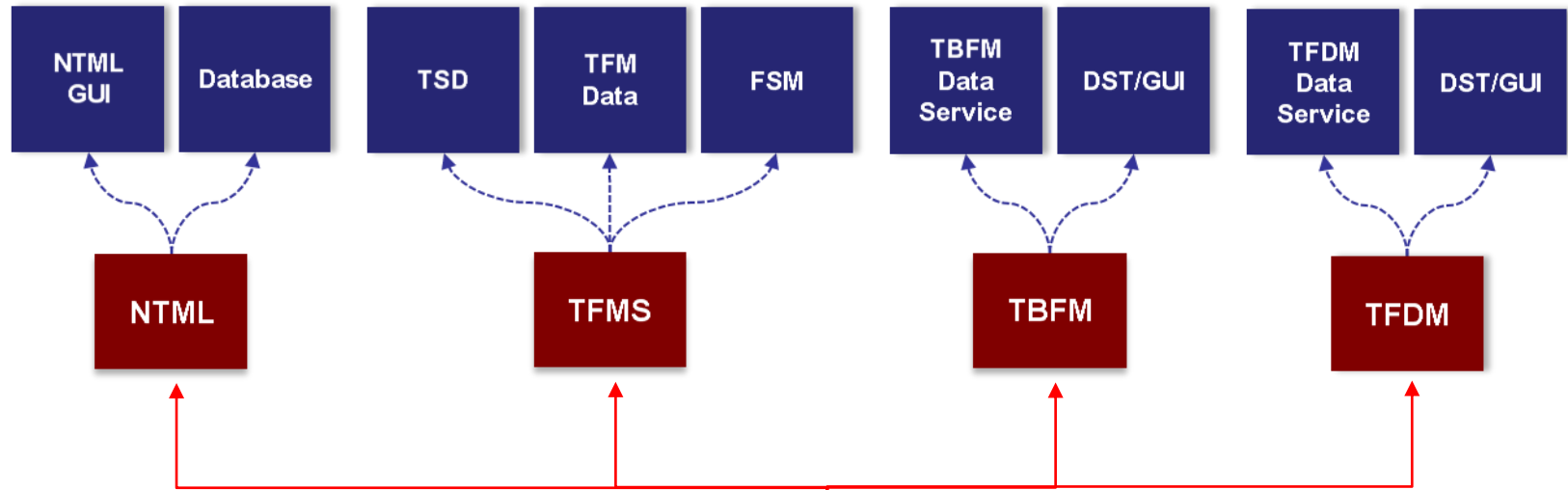
Ontology Features (cont.)



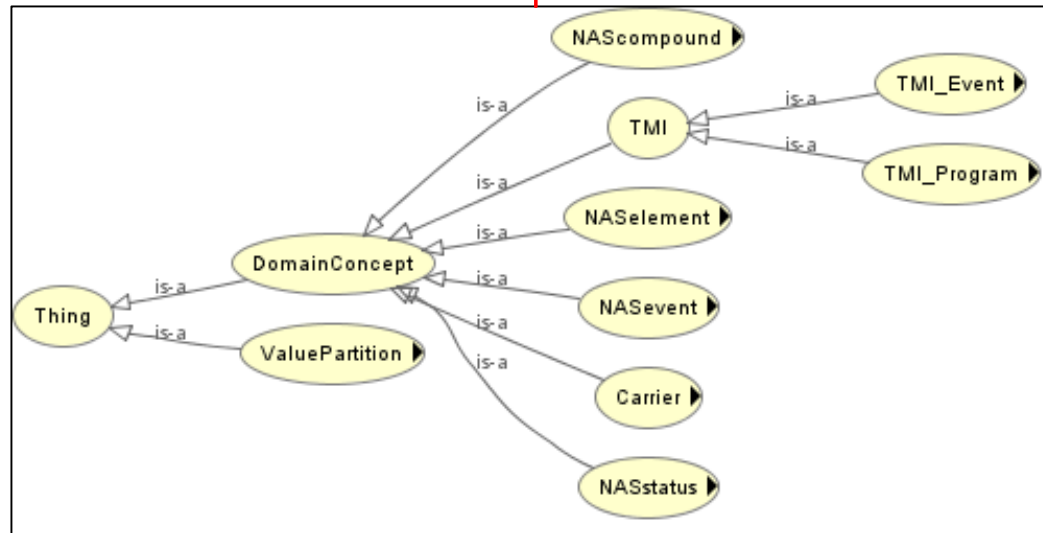
7. Inclusion of sub-carriers and relationships to major carriers
8. Inclusion of “Proposed/Actual” property to all TMLs, supporting electronic collaboration of TMLs prior to implementation
9. Universal causal factor list
10. Ability to specify the NAS element, aircraft, or another TML for which a TML event is being issued
11. Enables dynamic menus

- How can the ontology be used?
 1. Design and naming conventions used by TMI-related databases (NTML, TFMS, TBFM, TFDm)
 2. Design of an XML standard for the exchange of flow information (TMXM)
 3. By Traffic Management DSTs to ensure consistent terminology, menu options, and required data attributes by TMI type

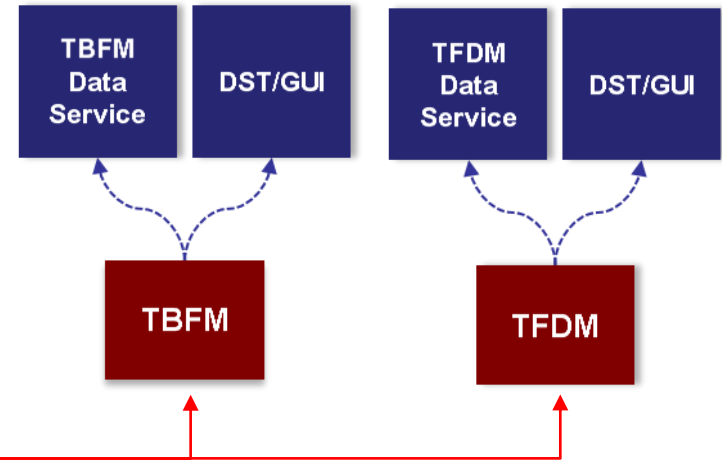
Integration with DSTs



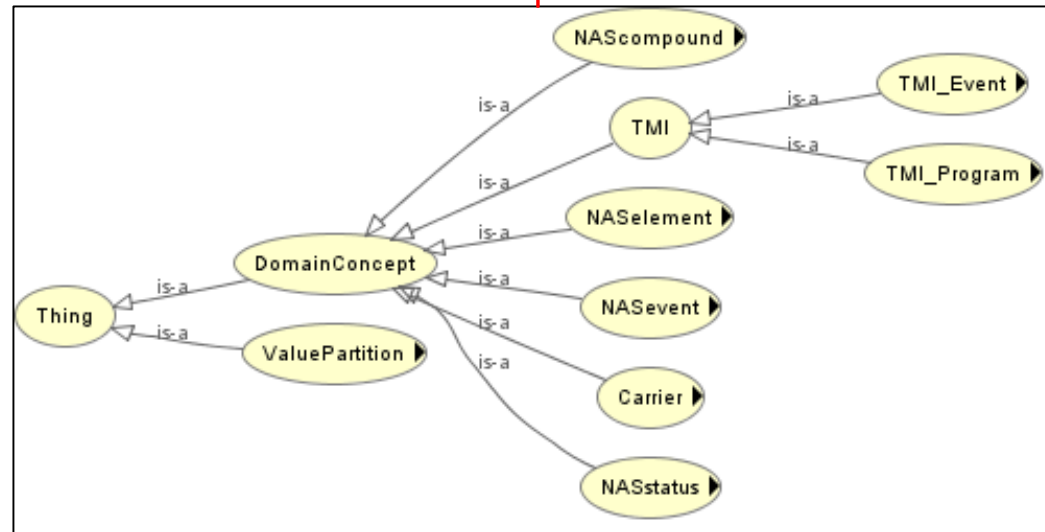
Today's Environment



Integration with DSTs (cont.)



NextGen Environment



Data Modeling Process

Conceptual Model

The real world view and understanding of data.

Identify entities and their relationships within a domain. Focus on business rules and user objects. Includes semantics. Can be captured via Entity-Relationship, UML class diagrams, or an ontology using OWL format.

Logical Model

Generalized formal structure in the rules of information science.

Represented in a normalized relational data model. Must include all attributes and their data types, and identification keys. Captured via Entity-Relationship or UML class diagrams

Physical Model

Specifies how the logical model will be executed in a particular technology.

Instantiation of the logical model in a specific technology, such as Oracle DBMS or XML.

Conceptual Model completed via the TMI Ontology

Summary

- A comprehensive ontology containing TMI attributes has been developed.
- Provides a number of benefits, including...
 - Acts as a conceptual model.
 - Provides a common language & terminology across NAS systems and data stores/feeds.
 - Foundation from which a logical model and ultimately physical models can be developed.
 - Single source to compare with existing NAS systems to identify required changes in order to support common TMI semantics.

Questions?