Network Manager
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AIXM 5.1 Temporality Concept

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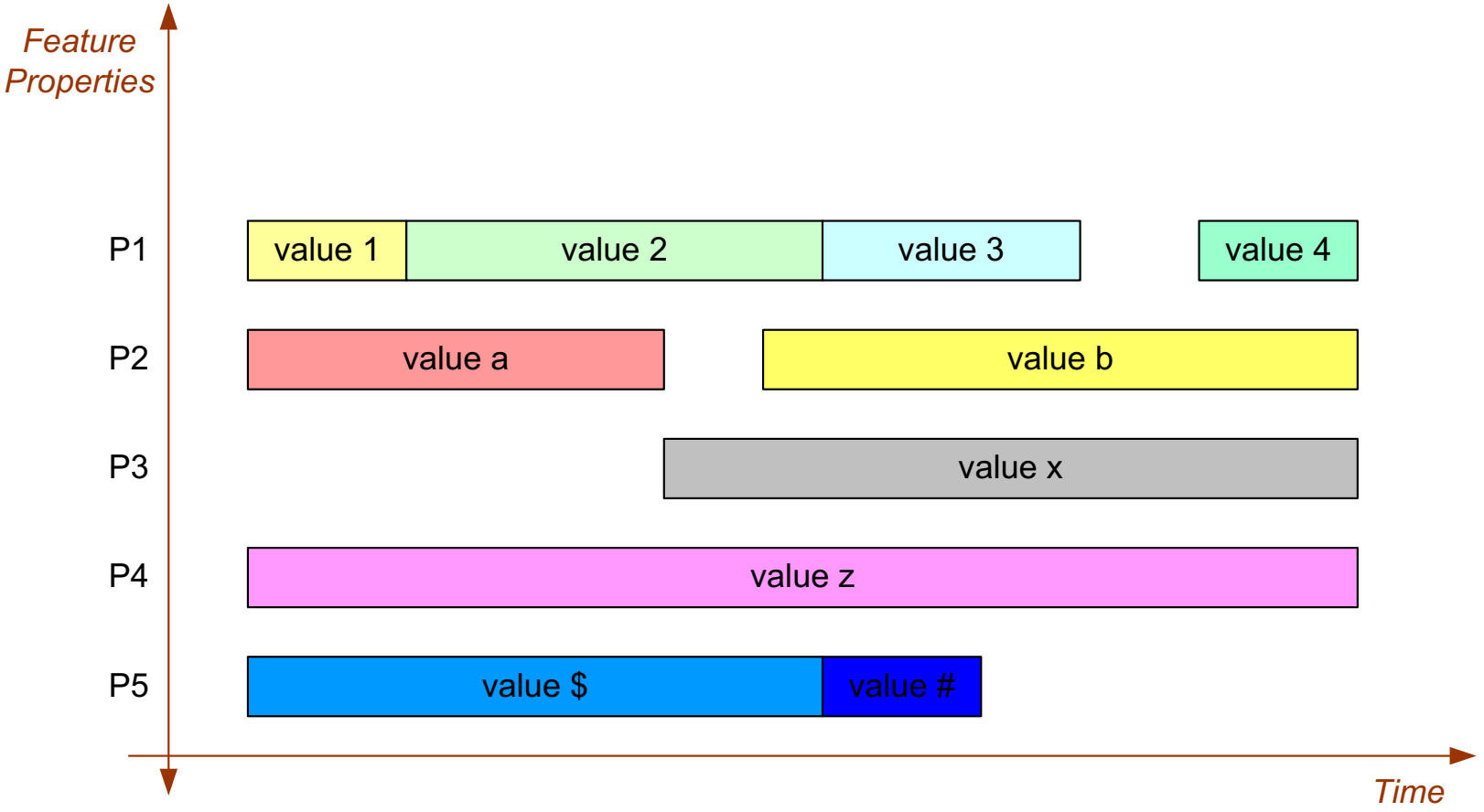
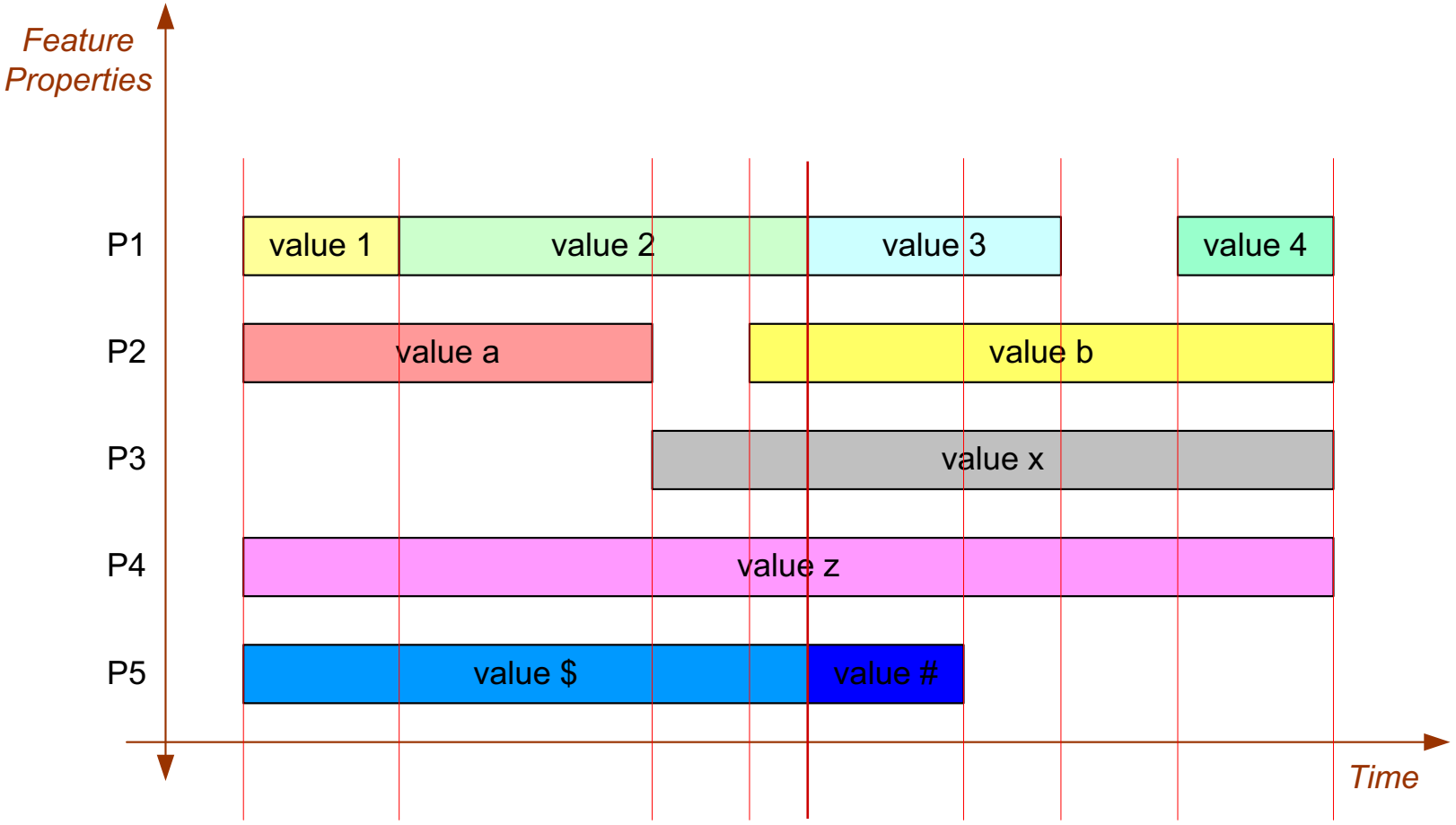
Temporality Model

- Definition
  - A model that incorporates the concept of time at feature level!
- Key assertions
  - All features are temporal with start of life and end of life
    - Example: a new air traffic control sector
  - All features can change over time
    - Example: a VOR changes frequency
  - Additional issue – feature properties can have different values according to a repetitive schedule
- AIXM Temporality Model
  - Relates feature properties to the time extent in which they are valid
  - Provides various means to describe the time extent

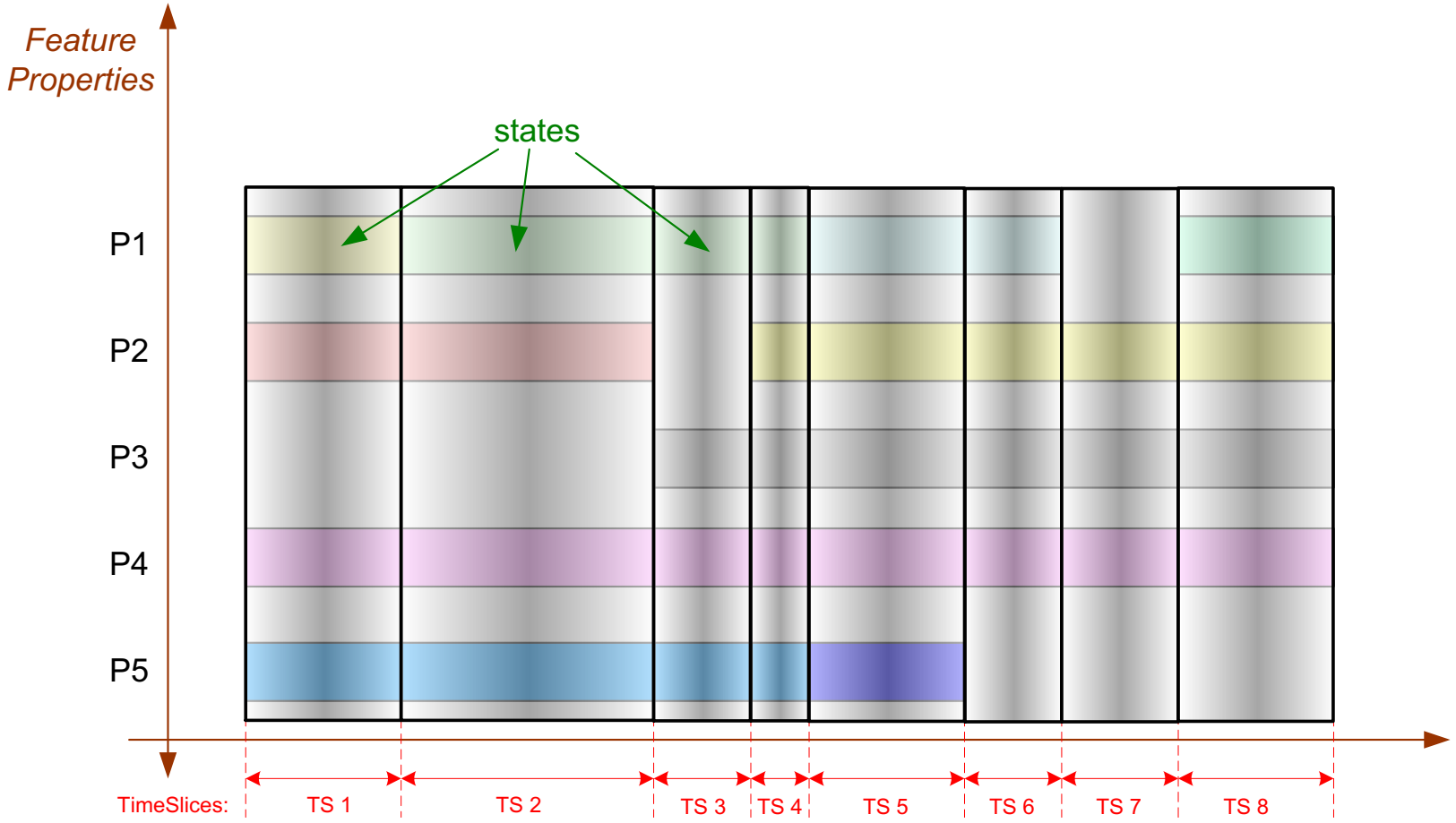
Features have time varying properties



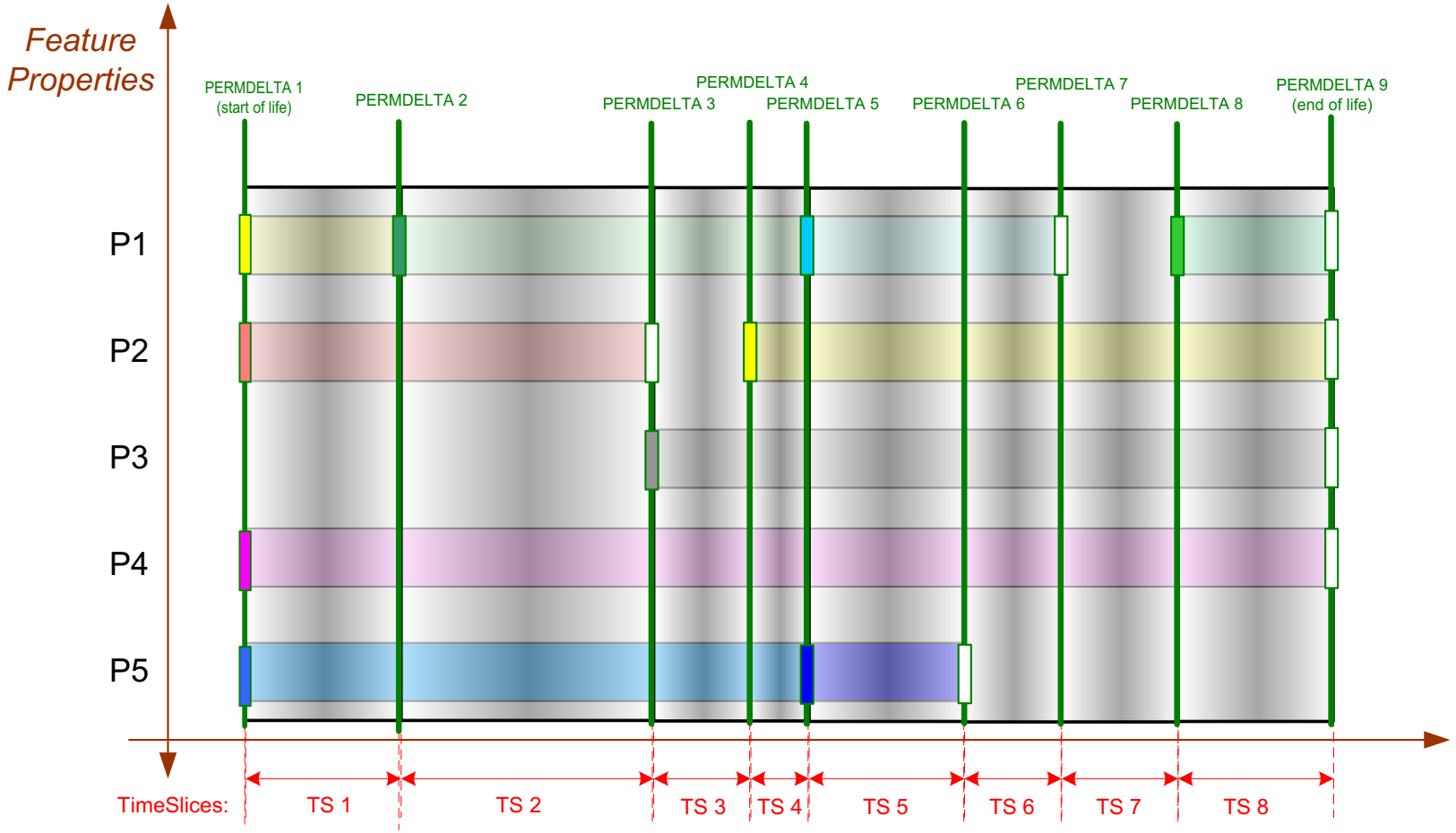
The basic Time Slice model



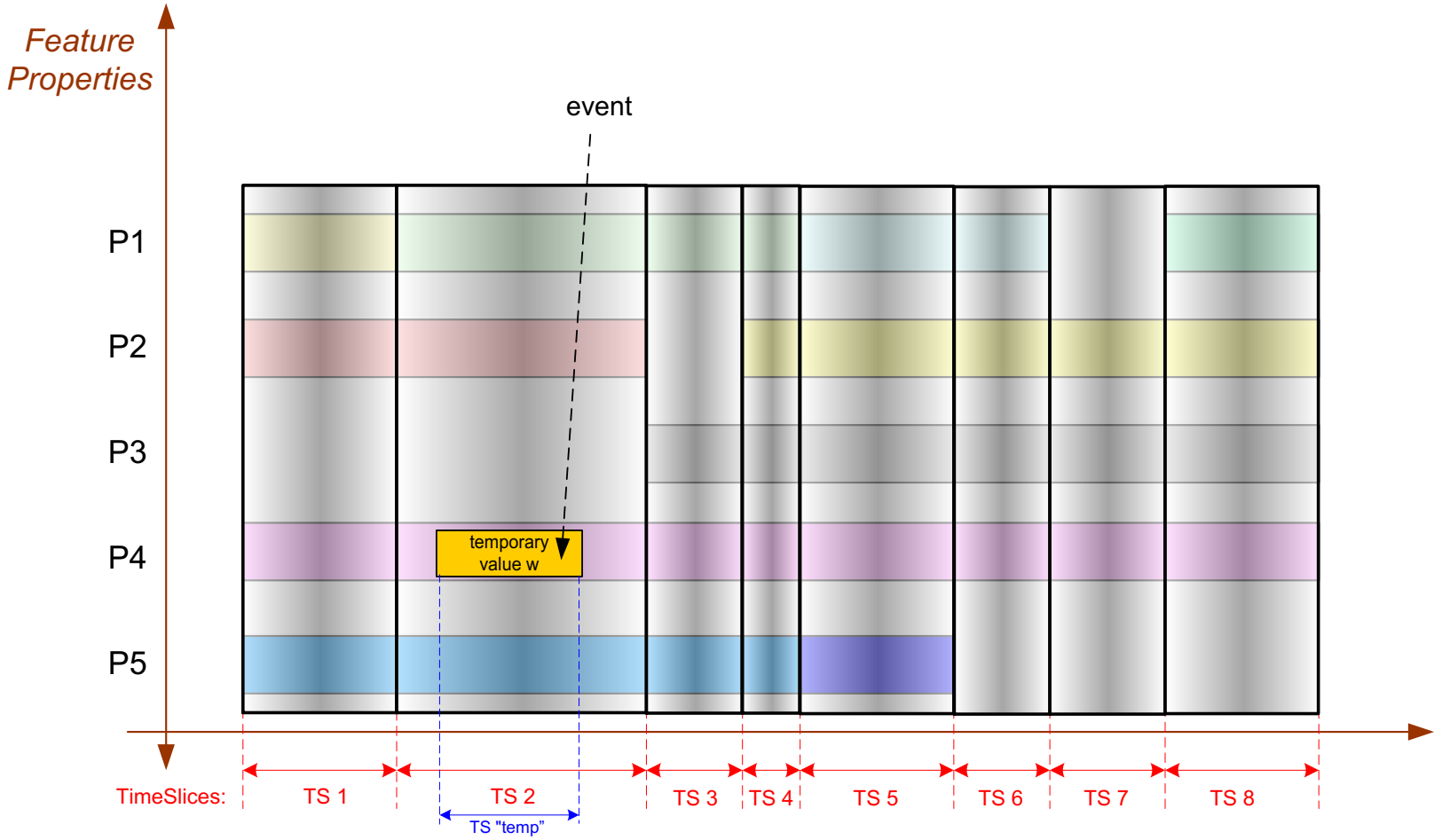
The basic Time Slice model



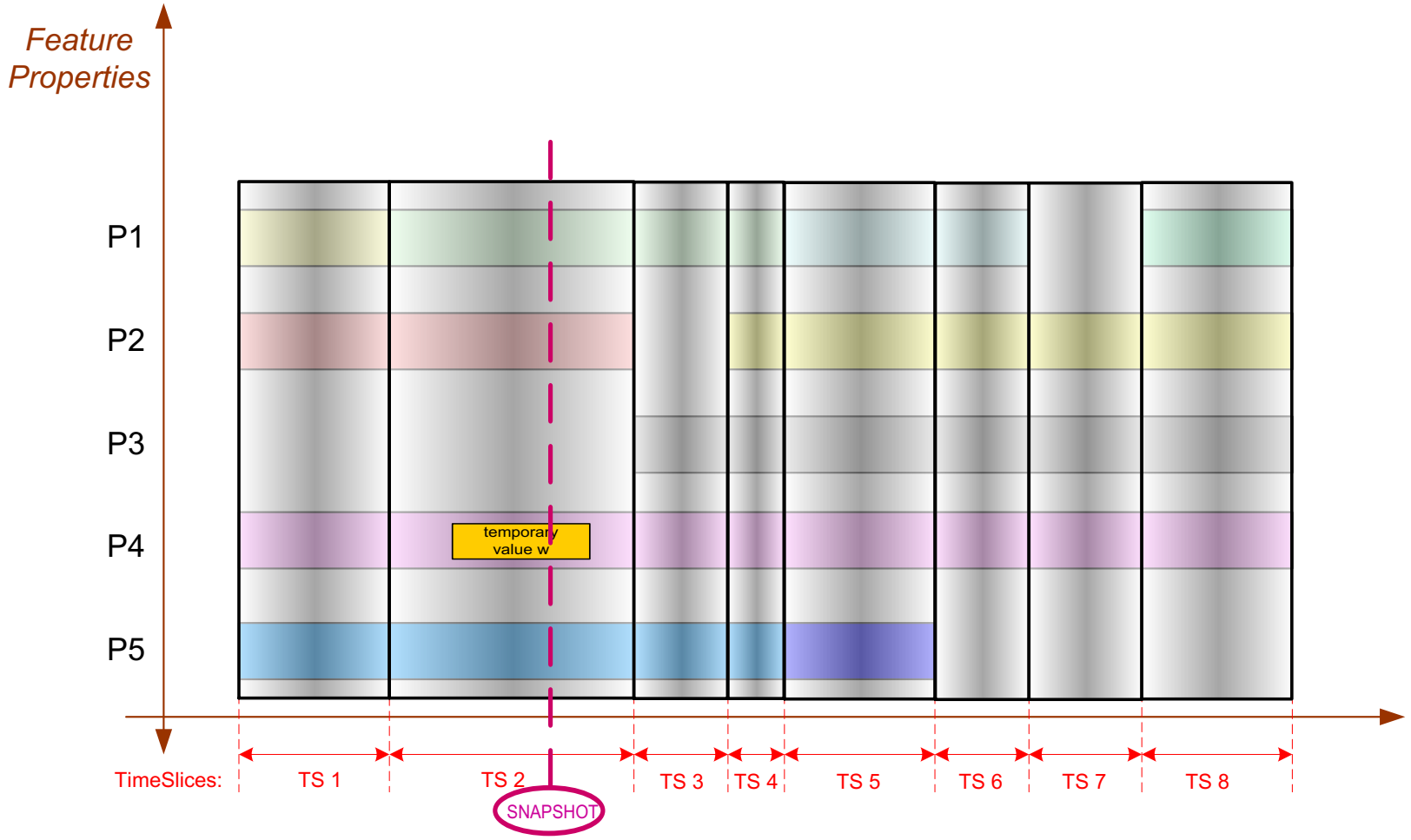
PERMDELTA TimeSlices



Temporary events (digital NOTAM)



Current status of a feature



AIXM Temporality document

1. The need for a temporality model

Time is an essential aspect on the aeronautical information world, where change notifications are usually made well in advance of their effective dates. Aeronautical information systems are requested to store and to provide both the current situation and the future changes. The expired information needs to be archived for legal investigation purposes.

For operational[1] reasons, a distinction is usually made between:

- *permanent changes* (the effect of which will last until the next permanent change or until the end of the lifetime of the feature) and
- *temporary status* (changes of a limited duration that are considered to be overlaid on the permanent state of the feature).

A temporary change includes the concepts of overlay and reversion. The temporary change is overlaid on the permanent feature state. When the temporary change ends, the temporary changes no longer apply and we revert back to the permanent feature state.

Note that, from an operational point of view, "temporary status" also includes the concept of "temporary features". However, from the AIXM point of view, temporary features are in no way different from normal features. The feature is created and withdrawn, just that the life span is shorter than usual.

In order to satisfy the temporal requirements of aeronautical information systems, AIXM must include an exhaustive temporality model, which enables a precise representation of the states and events of aeronautical features. In particular, this shall enable the development and the implementation of digital **NOTAM**. By digital NOTAM we mean replacing the free text contained in a NOTAM message with structured facts, which enable the automated processing of the information.

A general temporal model should be uniformly applied to all aeronautical feature types and the temporality concept should be abstracted from the task of modeling object properties. At the conceptual level, the model should describe the temporal evolution of the features, as they occur in the real world. This shall be done in compliance with the following rules:

- Completeness - all temporal states must be representable;
- Minimalism - use of minimal number of elements;
- Consistency - no reuse of elements with different meaning;
- Context-free - meaning of (atomic) elements independent of context; no functional dependency of (atomic) elements at the data encoding level;

The data exchange specification shall support the conceptual model. In addition, convenience elements ("views") may be introduced in the data exchange specification in order to facilitate the operations. This means that the data exchange specification may deviate from the "minimalism" rule.

[1] For example, systems that produce printed aeronautical documentation (AIP, charts) tend to ignore temporary status information; only the static data is represented on such printed products.

2. Building the Temporality Model

2.1 (step 1) Time varying properties

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

- Every feature has a start of life and an end of life;
- The properties of a feature can change within the lifetime of the feature; this includes the possibility for a property to not be defined over a time period.

The start of life and the end of life may also be considered as feature properties (attributes). This gives the following high-level list of properties for any AIXM feature:

- a global unique identifier;
- the start of life (date and time);
- the end of life (date and time);
- attributes and associations that qualify, quantify or relate in some form that feature.

It is considered that any feature property may change in time, except for the global unique identifier. This is a key assumption of the AIXM Temporality model.

The first step in the construction of the AIXM temporality model is represented by the diagram below, which shows the values of a feature's properties (P1, P2, … P5) along a timeline.

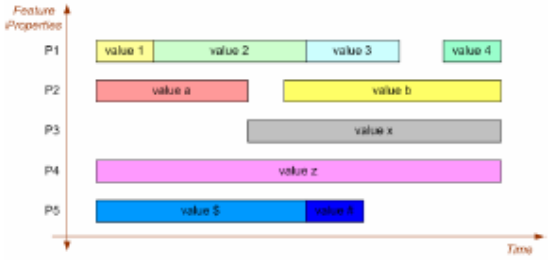


Figure 1

Discussion: *Can the start of life and the end of life properties of a feature vary in time?*
At first sight, probably not. A feature is created at a moment in time and will cease to exist at another moment in time. But this is true only when considering the already known history of a feature. When exchanging data about the future, there might be situations where the start/end of life is planned to happen at a certain date/time and this date might change.
Therefore, we have to include the start/end of life of a feature in the time varying properties list.

See www.aixm.aero

Example – abstract

Start of life

Feature

gml:identifier

TimeSlice

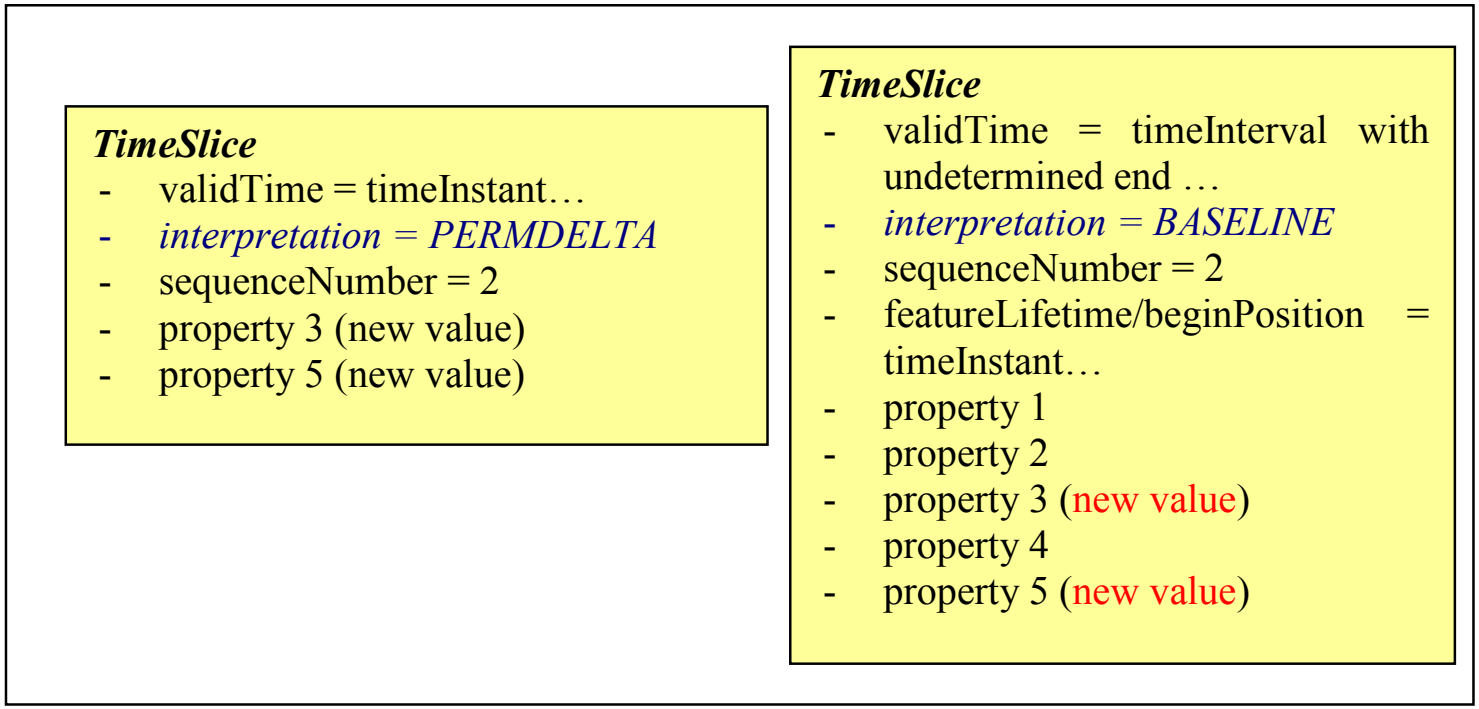
- validTime = timeInstant…
- *interpretation = PERMDELTA*
- sequenceNumber = 1
- featureLifetime/beginPosition = same timeInstant…
- property 1
- property 2
- property 3
- property 4

TimeSlice

- validTime = timeInterval with undetermined end
- *interpretation = BASELINE*
- sequenceNumber = 1
- featureLifetime/beginPosition = same timeInstant…
- property 1
- property 2
- property 3
- property 4

Example - abstract

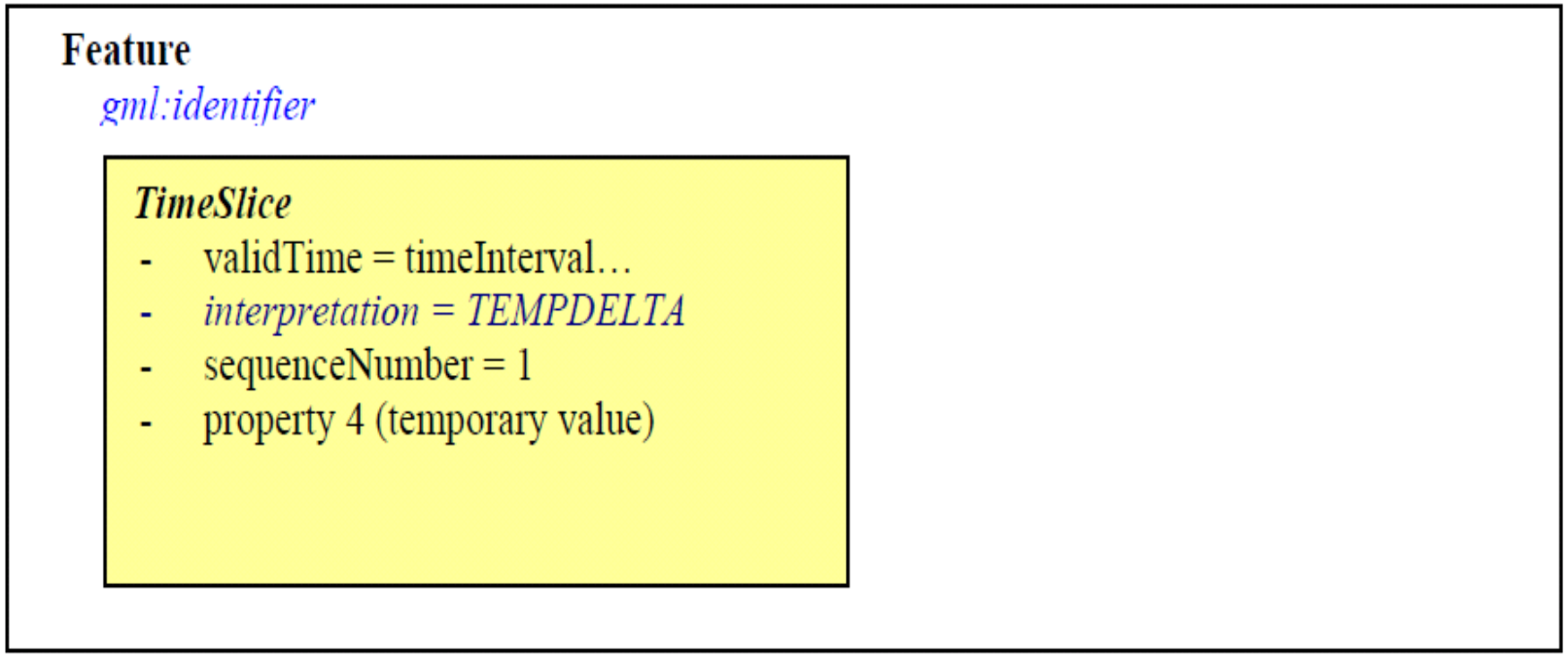
Permanent Changes



Attention:
"DELTA" for complex properties (objects) – see section 3.4
"DELTA" for multi-occurring properties – see section 3.5

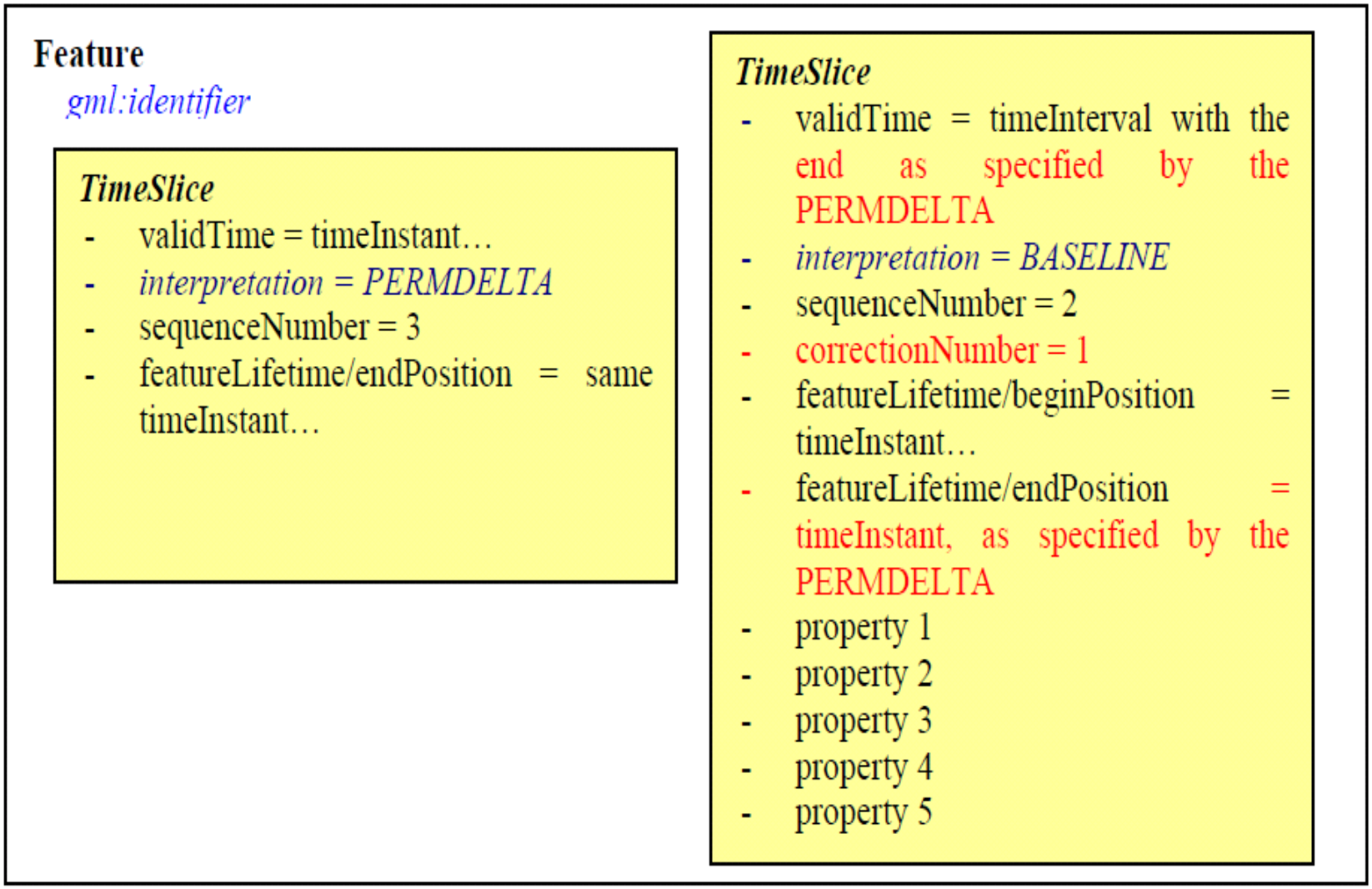
Example - abstract

Temporary change (NOTAM)



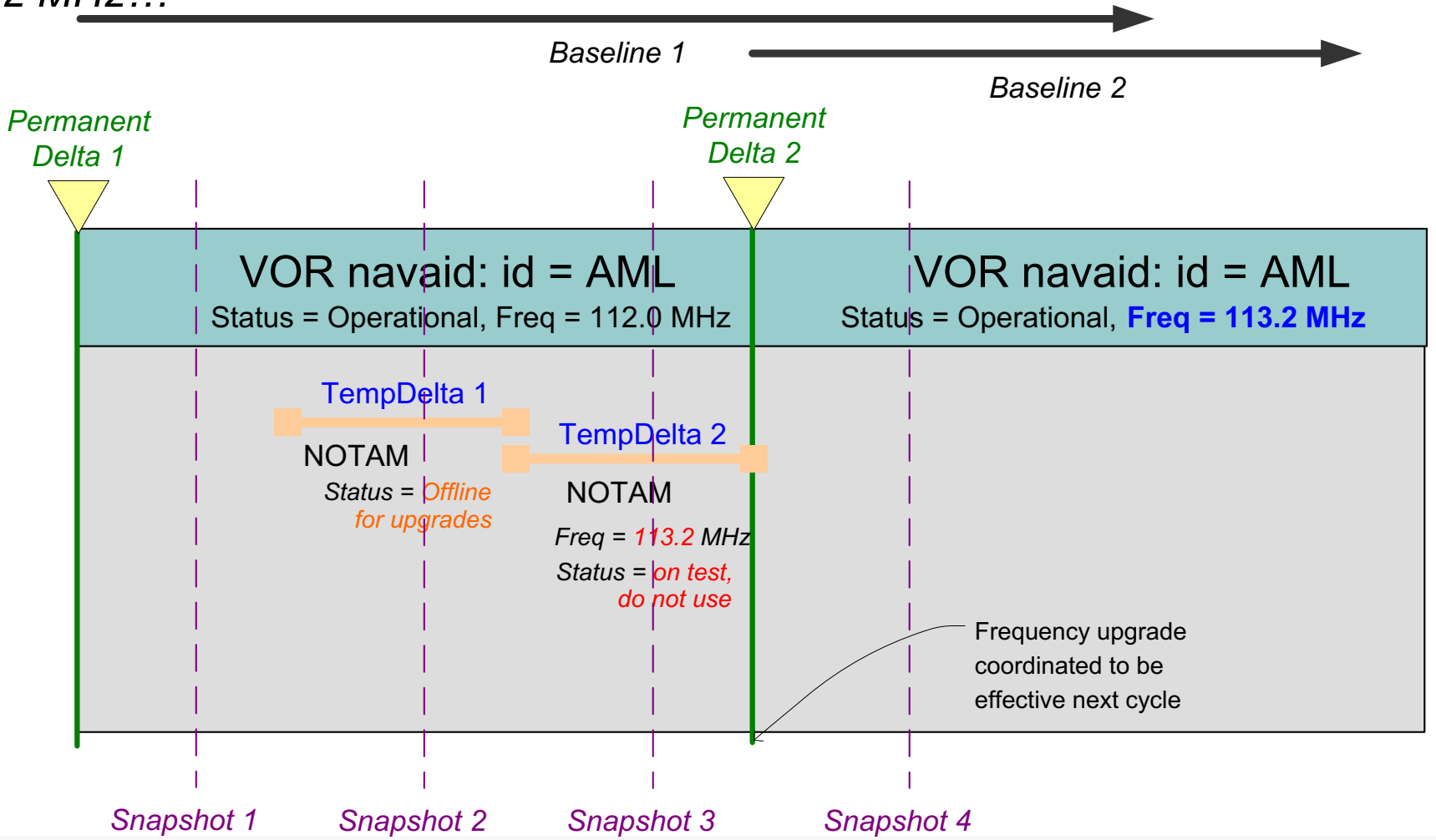
Example - abstract

End of life



An Example: Navaid frequency change

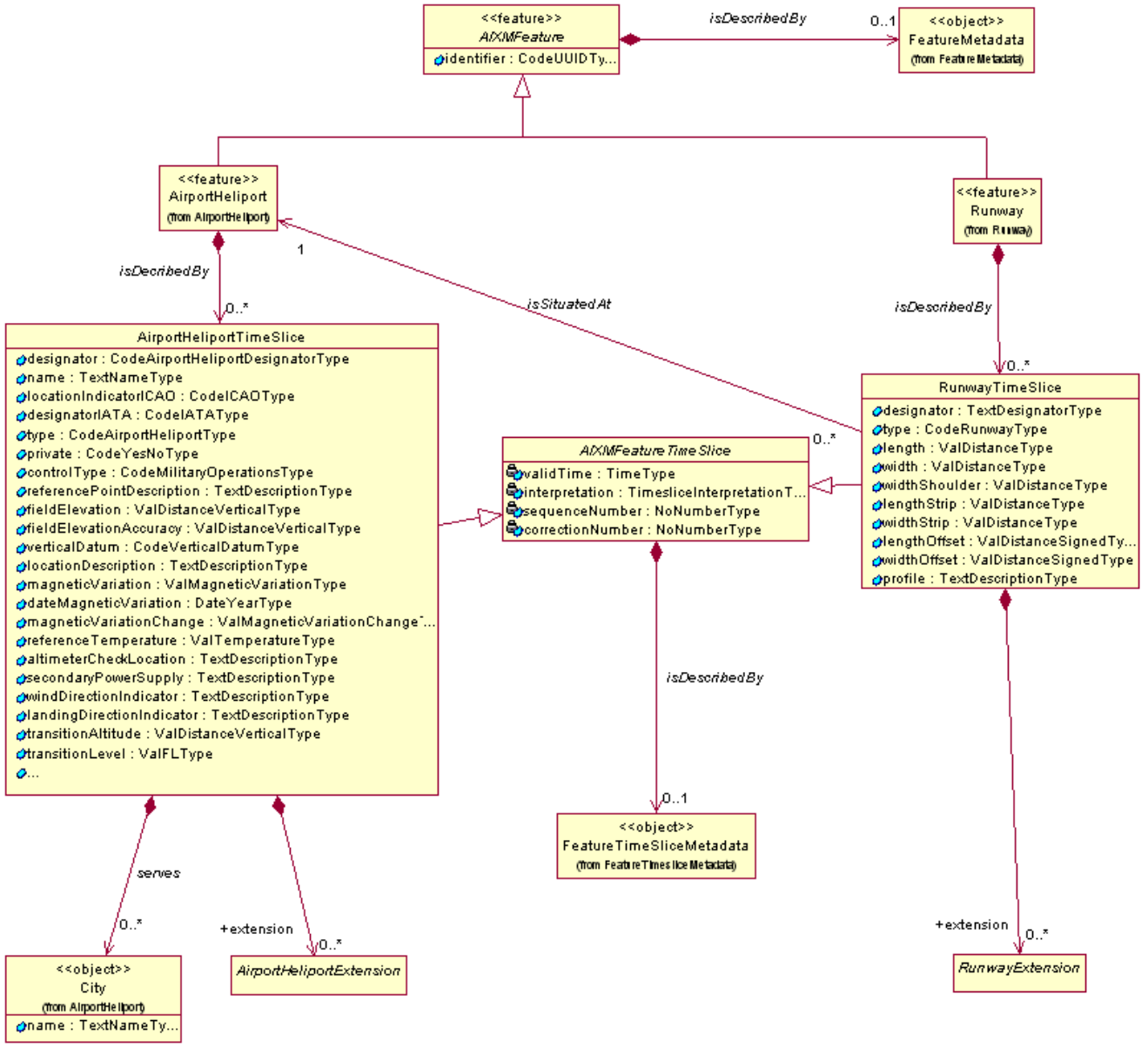
AML Navaid undergoes an upgrade that changes its frequency from 112.0 MHz to 113.2 MHz…



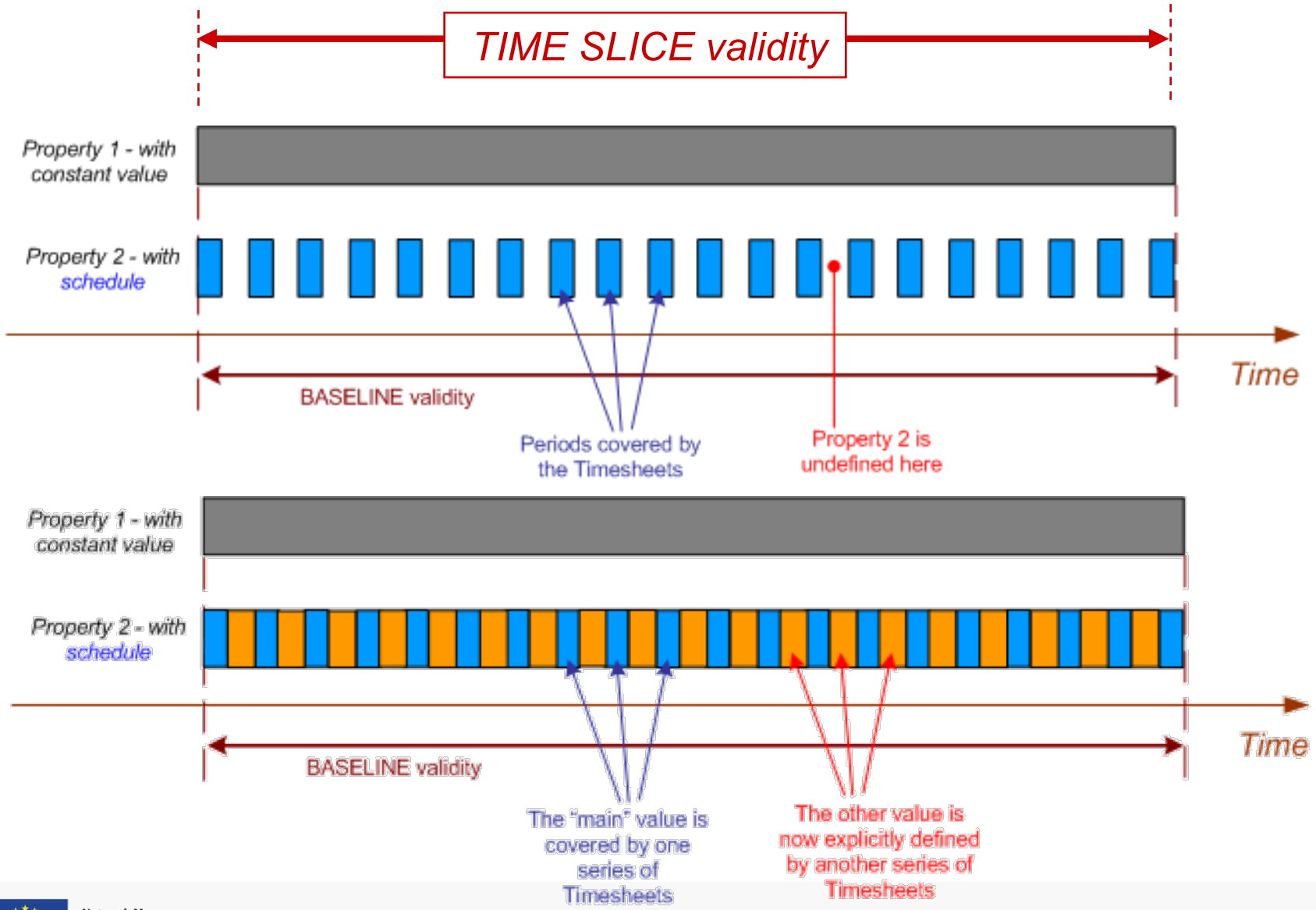
Temporality applied to the abstract model

Current AIXM 5.1 UML does not include this.

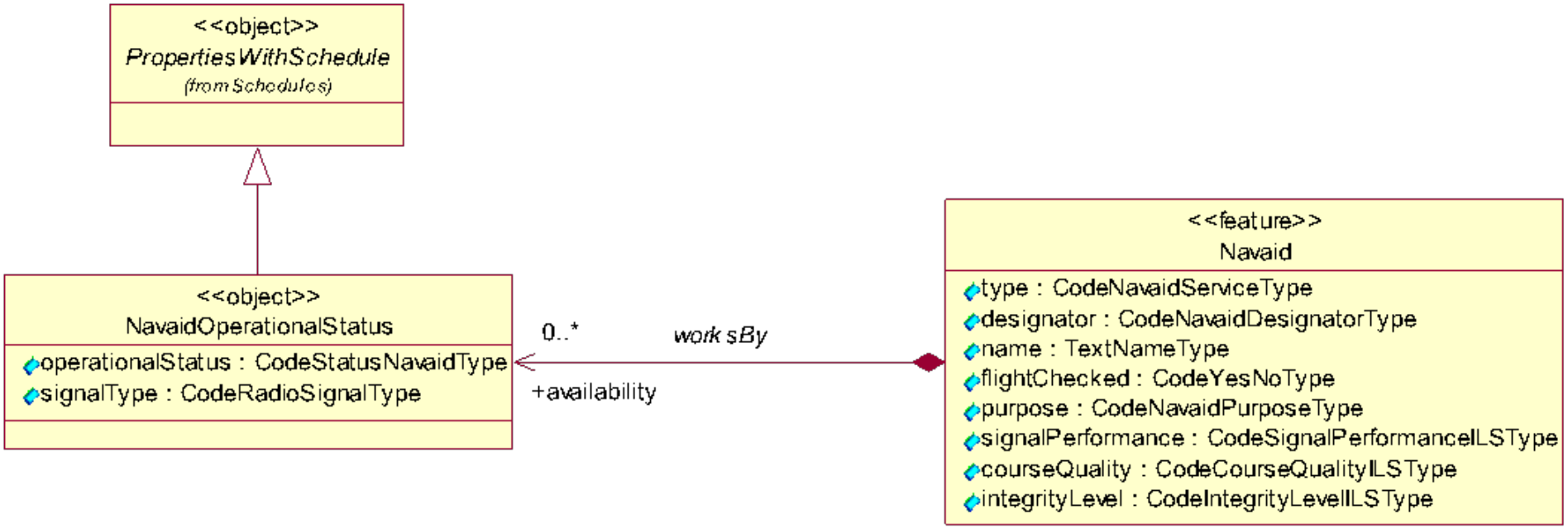
Temporality is applied directly at XSD generation time.



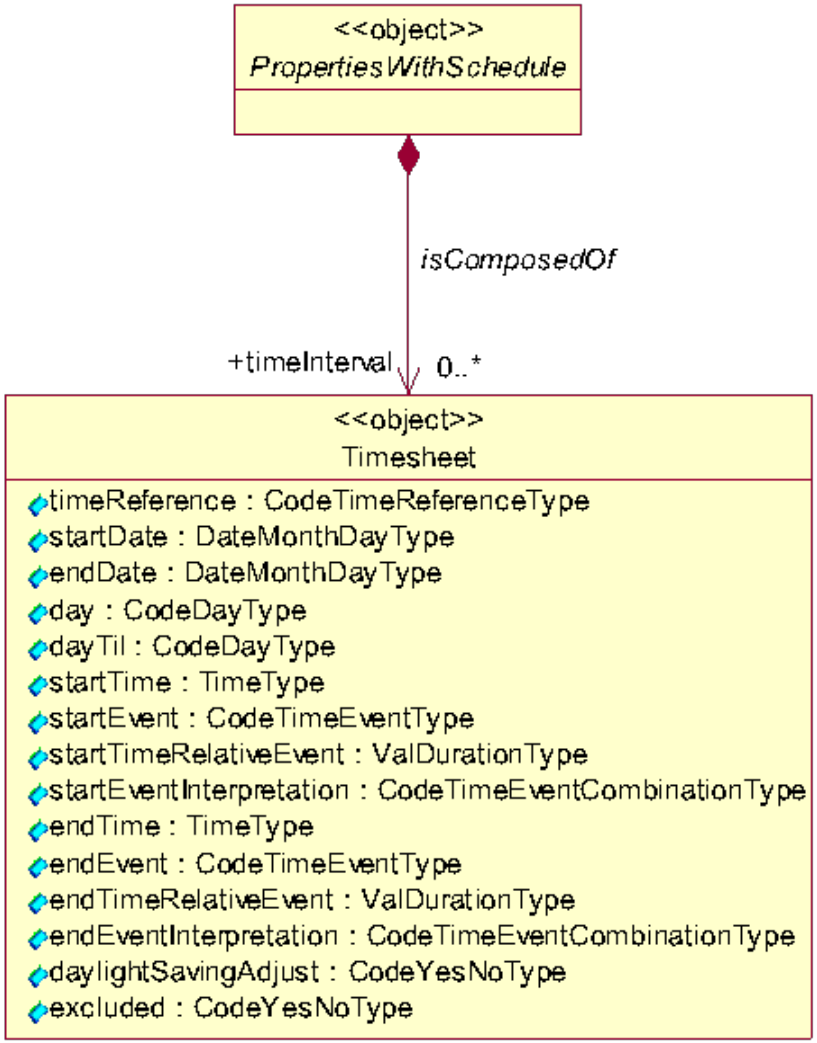
Properties with schedule



Properties with schedule



Properties with schedule



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Questions?