Department for Transport traveline

Fares and NeTEx Workshop

Manchester

November 2018

	Getting to know NeTEx
	NeTEx Basic fares profile - detailed
	NeTEx routes and timetables - detailed
	Preview of Complex fares requirement
	Questions and Next Steps

Department for Transport

A Basic UK fares profile

Objectives

- Discuss detailed scope of possible UK Bus Fares Profile
- Show how key features of UK Bus fares are represented using NeTEx
  - Simple UML & XML examples
- Get Feedback from you as to scope, phasing and implementation options

Department for Transport

Use Cases & Requirements determining scope of a UK Fare profile

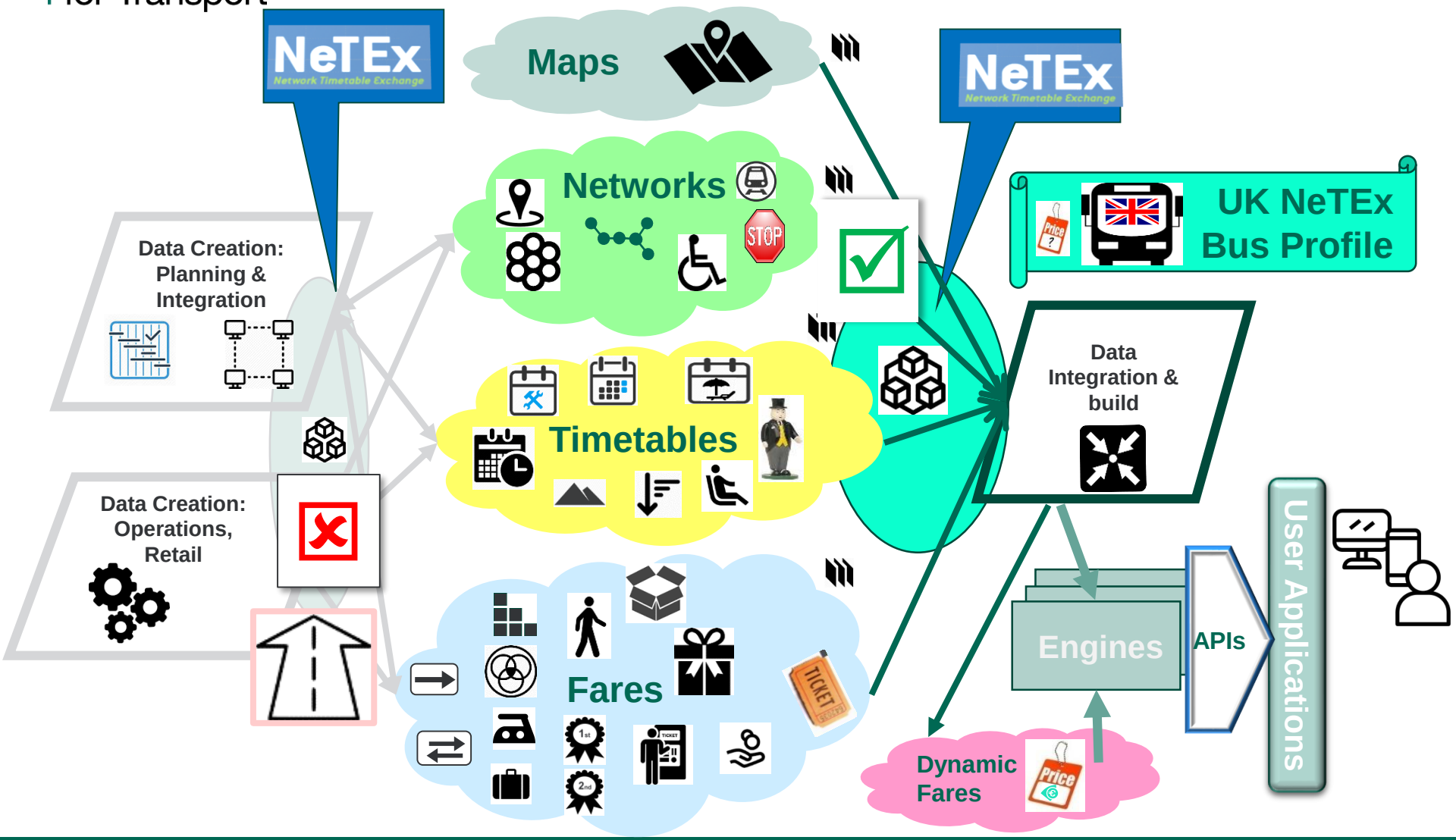
Requirements are marked:

☑ Needed?

Possible?

☒ Out of current scope / On Future roadmap?

Main use case is Fare & Price distribution – i.e. Downstream



Department for Transport

#1.2: The Data Distribution Use Case

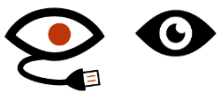
- **Provide fare products & fare prices as open data for third party use (in journey planners, etc.)?**

- Describe **available fare products** and their eligibility conditions. ☑

- Relate **fare products to network and timetabled journeys** so trip planners can compute fare products and fare prices for trips, show available products for area, etc. ☑

- Allow the s**eparate exchange of prices** from fare structures & products. ☑

- Expose a **justification of the fare** (Distance, discounts etc) ?



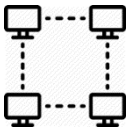
- Support both **machine readable** & **human readable** representation of validity parameters. ☑

- Include information about how/where products **can be bought**. ☑

- Include fares valid for specific and **multiple operators**. ☑

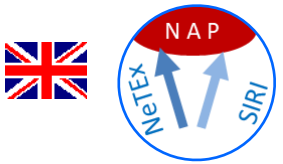
Department for Transport

Profile Scope - #2 Workflows



- **Data Architectures & Workflows?**
  - **Distributed Peer to peer** : Operator places data on website. ☑
  - **Managed:** An intermediary aggregates and integrates. ?

- **Granularity of exchange?**
  - **Network scope:** Network / Operator / Line / Timetable / Region.. ?
  - **Frequency:** (Annual, Monthly, Periodic, when it changes…) ?
  - **Prices:** Exchange separately from Fare Structure? ☑



- **How does data become available at a UK National Access Point?**
  - Discovery / Directory / Register? ?
  - Specify Tagging to enable search? ?

- **What needs to be included in the data to enable self describing data & validation of the above?**
  - Operator, validity conditions, code values, etc. ?

Department for Transport

Profile Scope - #3 Prices?

What Prices are needed?

1. **Final Prices** for every parameter combination ☑

1. **Base prices** + **Derivation parameters** ☑
   - PRICING RULE as percentage of another price
   - Need rounding steps and any minimum/maximum limits

2. **Dynamic Prices?** ?
   - No actual prices are exchanged, instead where to fetch an online price for a given product choice.

3. **Price Groups?** ☑
   - Where Price is common to several elements

Department for Transport

Profile scope - #4 Modes?

Can be covered by Basic Products ☑

- **Bus**
- **Bus as add-on** to Rail etc (e.g. Plus bus)
- **Ferry**
- **Light Rail**, **Tram**?

Require additional complex products ☒

- **Coach**? (Seat Reservations, luggage, Routing?….)
- **Metro** / London Underground, PAYG, Capped fares)
- **Rail** (routing, advance products, etc)

Department for Transport

Profile scope - #5 Interoperability?

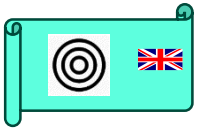
- **Network & Timetable data**
  - NPTG Localities ☑
  - NaPTAN ☑
  - TransXChange Line / Journey ids ☑
  - NOC Operator codes ☑
- **A UK Bus CSV representation of Fare Triangles?** ?

  - Similar to NaPTAN stop csv
  - Asic Tariff StructuresDistance Matrix Elements
  - Products
  - Tariff Prices
    - O/D x product/user type/ x x price

- **GTFS Fare Rules Translation?** ✗

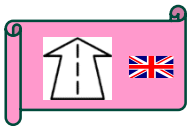
Department for Transport

A Strawman for the UK Bus Fare Profile



Basic UK Profile

Advanced UK Profile



Exclude / Long term roadmap

Department for Transport

Agenda for Discussing Scope

Network Basis

Tariff Structure

Access Rights

Fare Product & parameters

Sales Offer Packages

- Which Network elements are needed
  - Operators, Stops, Lines, Tariff zones etc
- Which Products / Access rights
  - Which Specific Tariffs / Fare Structures?
  - Which Access rights:
    - Single, Return, Season Pass, Return, etc
- Which Product Parameters?
  - Which User Types,
  - Which conditions of use
  - Which conditions of sale
- Which Sales Offer Parameters>
  - Distribution Parameters
- What sort of Prices are needd
  - Base, Derived, Dynamic

Basic UK Bus fare products?

Department for Transport

Access rights		Tariff Structure						
Type of Product	PREASSIGNED FARE PRODUCT	Flat	Point to point	Named Zones	Zone/ Stage Count	Peak / Off Peak	Group Ticket	Temporal Conditions
TRIP *("single ride")*	*Short hop*	☑	☑	☑	☑	?	-	No break
	Single trip	☑	☑	☑	☑	☑	☑	Has use by date?
	Time-limited ("Hopper")	-	-	☑	-	☑	☑	Max trip duration, Can interchange
	Period Return	☑	☑	☑	-	☑	☑	Has use by date?
	Day return	☑	☑	☑	-	☑	☑	Must use same day
PASS	*Day pass*	-	-	☑	-	☑	☑	1D (elapsed or calendar)
	Termtime	-	?	☑	-	-	-	Use during term 1Y
	Season pass	☑	☑	☑	-	-	☑	n x D,W,M, 1Y

Department for Transport

More complex UK Bus fare products - Carnets: Multi-trip / Multi-pass offers

Access rights		Tariff Structures		
Type of Product	FARE PRODUCT (AMOUNT OF PRICE UNIT)	**Quantity**	**Related tariff structure**	**Temporal Conditions**
CARNET	***Multi-trip***	☑	Any individual Trip	Trips have use-by date Trips can be time limited
	Multi-Day pass	☑	Day Pass	Passes have specified duration Passes have use-by date

The Basic Bus Fares

Department for Transport

SINGLE TRIP

Point to Point

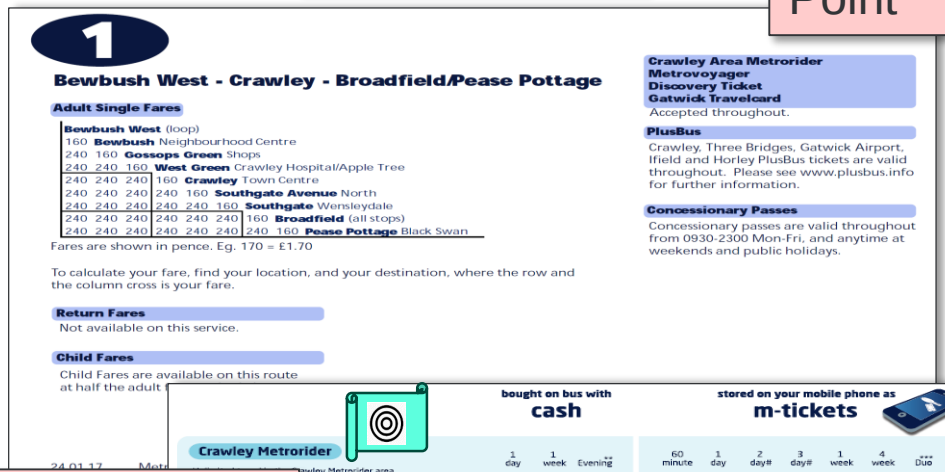
FARE SECTION

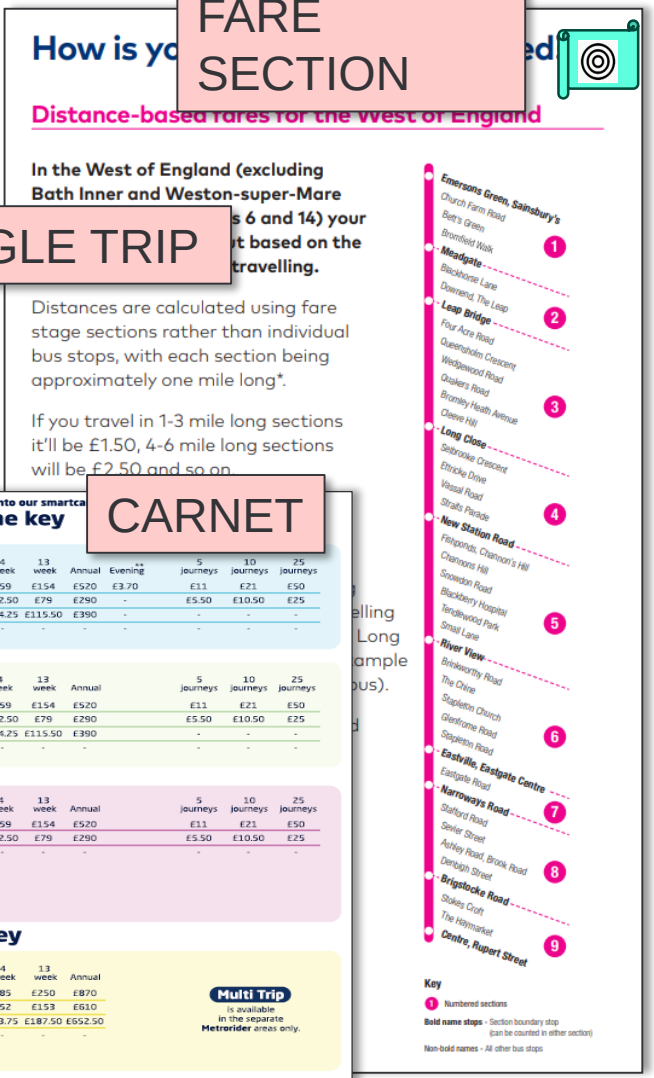
SINGLE TRIP

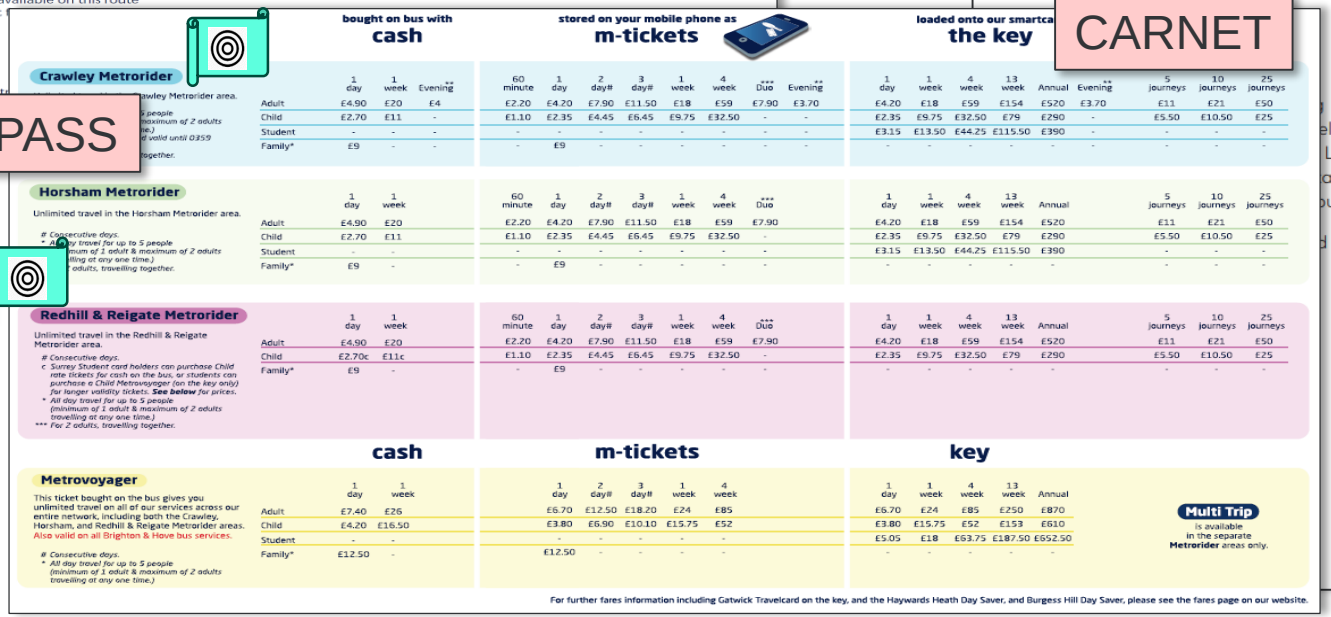
PERIOD PASS

CARNET

ZONAL







Department for Transport

Network & Timetable elements needed to define Tariff Structures

Network Basis

- Network Journey & Timetable Elements

Department for Transport

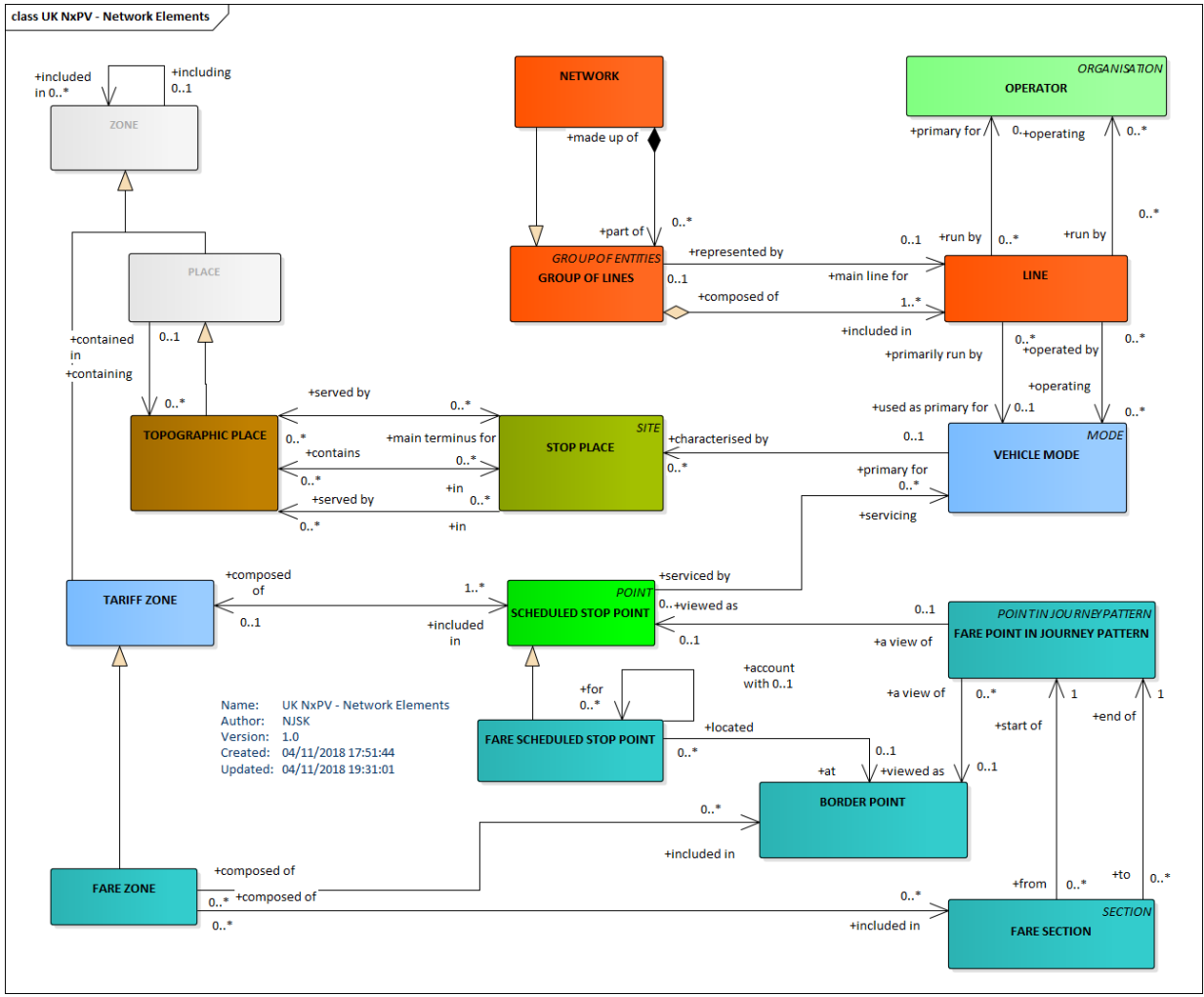
Network elements for tariff and product definition

- Fare structures build on NeTEx Part1 & Part2 Network & Timetable elements
  - Equivalent to NaPTAN, TransXChange
- Mostly the same elements as defined in UK Basic Timetable Profile
  - MODEs, OPERATORs, LINEs, etc
  - Fare definitions can reference /or include them
- Some elements extended for fares:
  - TARIFF ZONE → FARE ZONE
    - Adds additional attributes
  - POINT IN PATTERN → FARE POINT IN JOURNEY PATTERN
    - Used to define Fare Stages for a route

Department for Transport

Network elements for tariff and product definition

- **Tariffs & Fare Products may apply to individual instances or combinations of**
  - MODEs
  - OPERATORs
  - LINEs
  - +GROUPS OF LINEs
  - +NETWORKs,
- **Tariffs structures may be based on**
  - STOP POINTs
  - +FARE ZONES (Tariff Zones)
  - +FARE SECTIONS
    - (FARE POINTs IN JP)



Department for Transport

OPERATOR –As in TransXChange XML Code Snippet

- Id is within a name space
  - Use National Operator codes
  - Additional external codes also possible

```
<organisations>v
    <Operator version="1.0" id="noc:METR">
        <PublicCode>METR</PublicCode>
        <PrivateCode type="metrobus:internalCode"> 456</PrivateCode>
        <Name>Metrobus</Name>
        <ShortName>Metrobus</ShortName>
        <TradingName>Metrobus Ltd</TradingName>
        <ContactDetails>
            <Phone>01293 449191</Phone>
        </ContactDetails>
        <OrganisationType>operator</OrganisationType>
        <Address>
            <Street>Wheatstone Close</Street>
            <Town>Crawley</Town>
            <PostCode>RH10 9UA</PostCode>
            <PostalRegion>West Sussex</PostalRegion>
        </Address>
        <PrimaryMode>bus</PrimaryMode>
    </Operator>
</organisations>
```

```
<OperatorRef version="1.0" id="noc:METR“/>
```

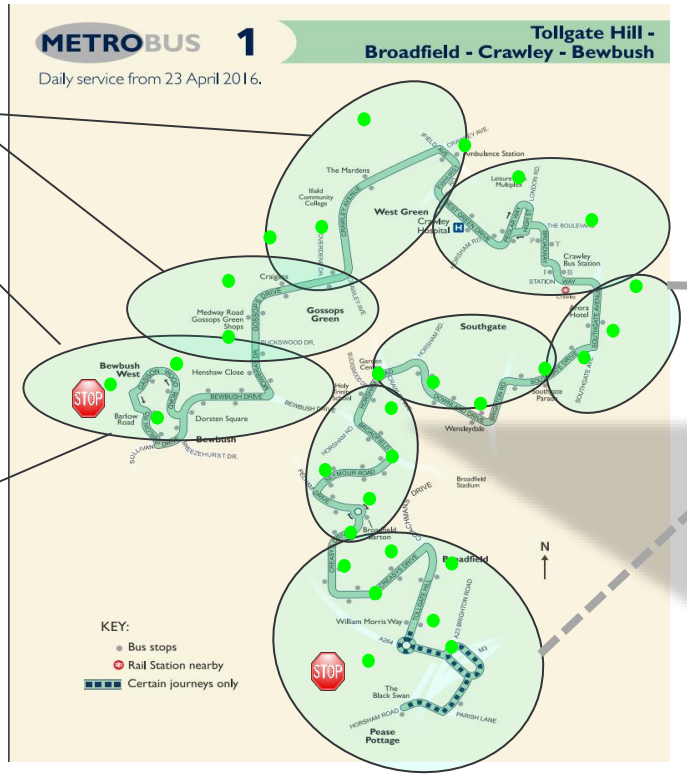
Department for Transport

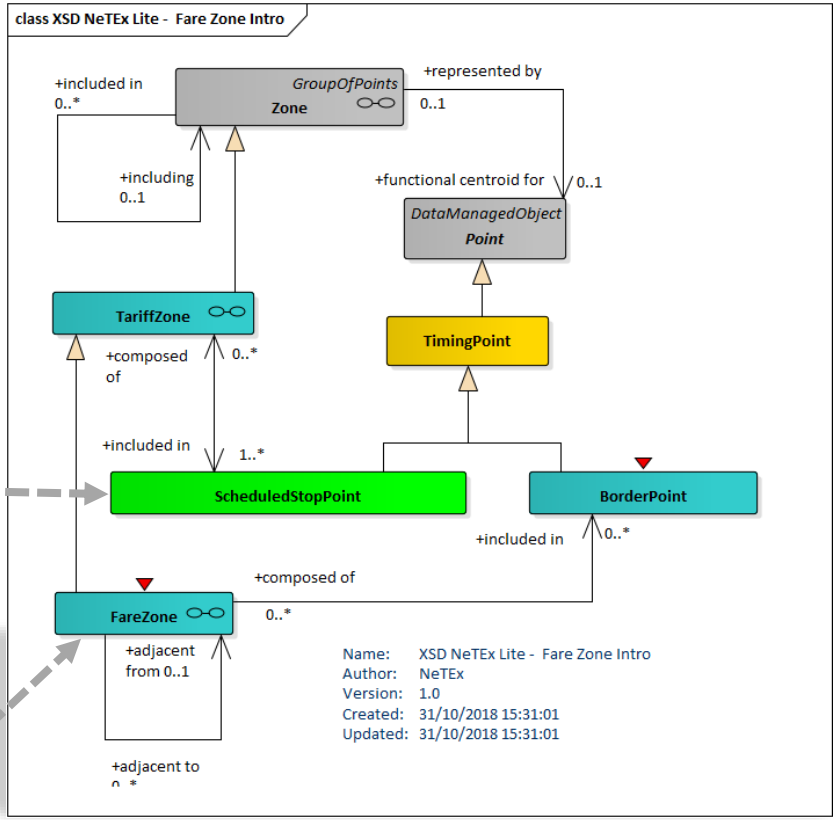
TARIFF / FARE ZONES

- Tariff Zones know their stops
  - All Zones can have a 2D spatial projection (ie polygon)

FARE ZONEs

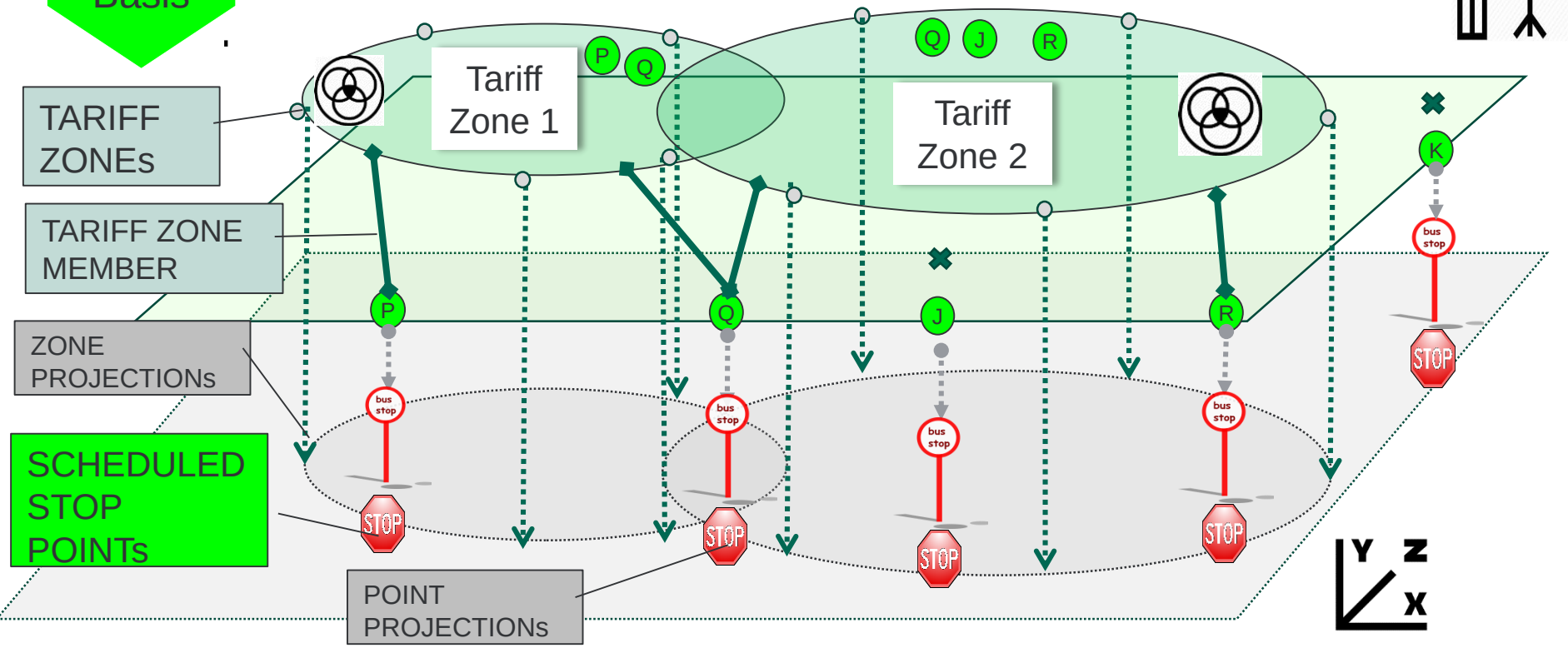
SCHEDULED STOP POINTs





Membership of Tariff Zones by Stops is explicit.

Network Basis



- ***The model specifies which stops are in which** tariff **zone:** a stop may be in more than one zone, zones maybe specific to an operator or shared.*
- ***Both stops and zones have a spatial projection.** However spatial containment of a stop within a zone's extent does not invariably imply semantic membership of the zone. In many cases the coordinates can be used to compute which stops are in a given tariff zone so as to populate the membership links.*
- *A Tariff zone may also **have presentation properties** such as colour.*
- *Tariff zones can also be related to **Topographic places** in a Gazeteer (ie NPTG localities)*

Department for Transport

Tariff /Fare Zones XML Code Snippet

- TARIFF ZONEs can reference existing NaPTAN STOP POINTS
  - NPTG already has PlusBus Zones with Polygons

```
<fareZones>
    <FareZone version="1.0" id="mb:fs@Bewbush_West">
        <Name>Bewbush West (loop)</Name>
        <members>
            <ScheduledStopPointRef ref="naptan:4400CY0037" version="any">Brettingham Close, Bewbush</ScheduledStopPointRef>
            <ScheduledStopPointRef ref="naptan:4400CY0038" version="any">Neptune Close, Bewbush</ScheduledStopPointRef>
            <ScheduledStopPointRef ref="naptan:4400CY0039" version="any">Mercury Close, Bewbush</ScheduledStopPointRef>
            <ScheduledStopPointRef ref="naptan:4400CY0040" version="any">Sullivan Drive, Bewbush</ScheduledStopPointRef>
            <ScheduledStopPointRef ref="naptan:4400CY0042" version="any">Bewbush Roundabout, Bewbush</ScheduledStopPointRef>
        </members>
    </FareZone>
    <FareZone version="1.0" id="mb:fs@Bewbush">
```

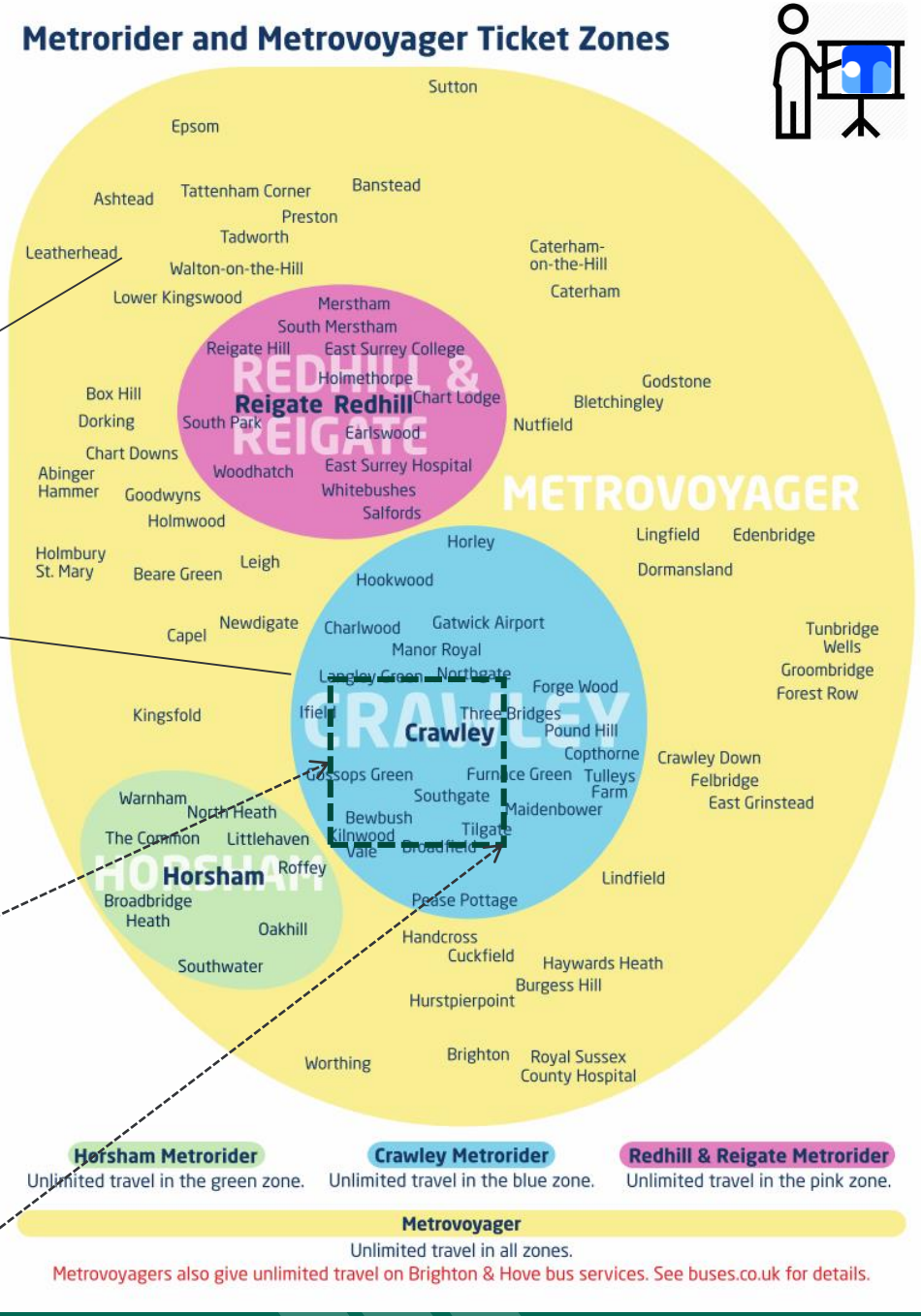
……..

Nested Fare Zones - Metrorider & Metrovoyager

TOPOGRAPHICAL PLACEs

FARE ZONEs

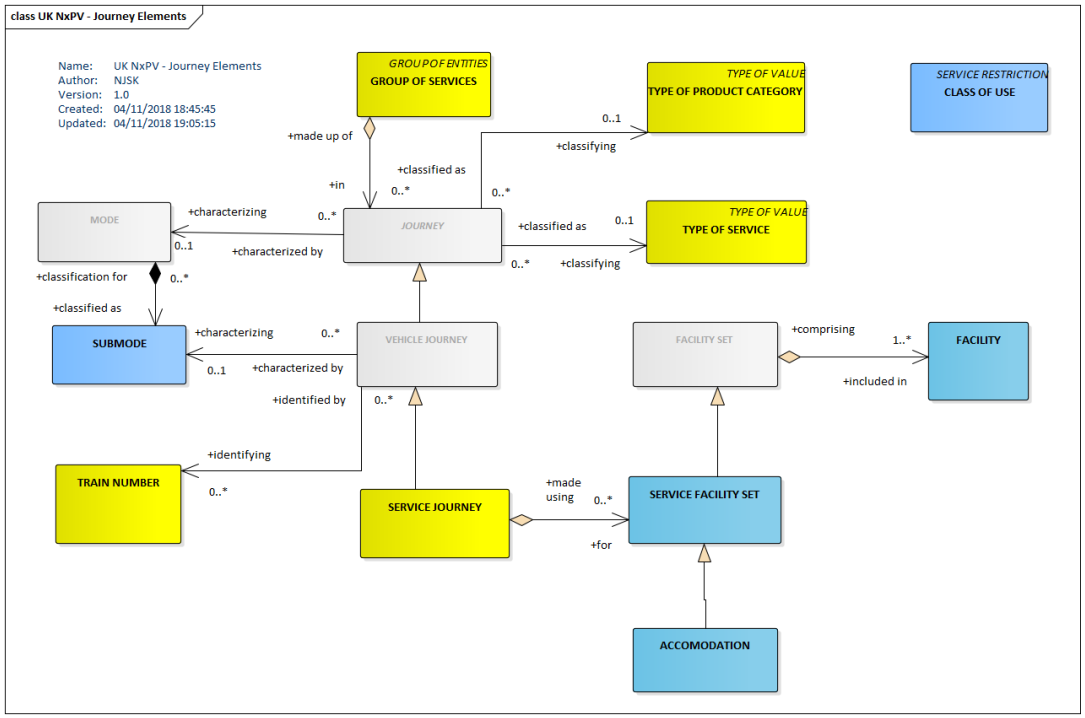
- ZONE topologies e.g
  - **NESTED**,
  - DISJOINT
  - HoNEYCOMB
  - OVERLAPPING



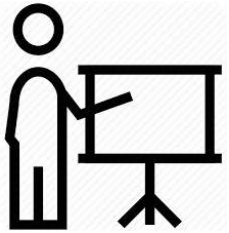
Department for Transport

Journey Elements for tariff definition

- **Tariffs may apply to specific journeys or to journey classifications: Mostly only relevant for Coach or Rail**
  - SERVICE JOURNEY
  - GROUPs OF SERVICES
  - TYPEs OF SERVICE
  - TYPEs OF PRODUCT CATEGORY
- **Tariffs may apply to facilities & specific accomodation**
  - CLASS OF USE
  - ACCOMODATION



Department for Transport



Tariff Structures & UK Bus FAres

Tariff Structure

Access Rights

Basic UK Bus fare tariff types?

Department for Transport

Access rights		Tariff Structure						
Type of Product	PREASSIGNED FARE PRODUCT	Flat	Point to point	Named Zones	Zone/ Stage Count	Peak / Off Peak	Group Ticket	Temporal Conditions
TRIP *("single ride")*	*Short hop*	☑	☑	☑	☑	?	-	No break
	Single trip	☑	☑	☑	☑	☑	☑	Has use by date?
	Time-limited ("Hopper")	-	-	☑	-	☑	☑	Max trip duration, Can interchange
	Period Return	☑	☑	☑	-	☑	☑	Has use by date?
	Day return	☑	☑	☑	-	☑	☑	Must use same day
PASS	*Day pass*	-	-	☑	-	☑	☑	1D (elapsed or calendar)
	Termtime	-	?	☑	-	-	-	Use during term 1Y
	Season pass	☑	☑	☑	-	-	-	n x D,W,M, 1Y

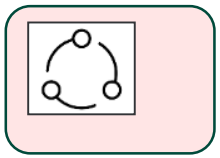
Metrorider zone

Department for Transport

Basic Product Types - terminology

- **Trip**

The product gives the right to make a single journey

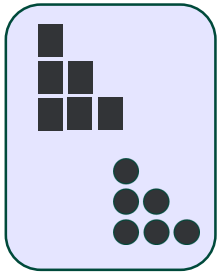


- **Pass**

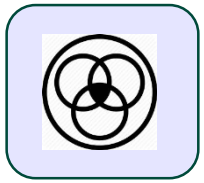
The product combines access rights to make repeated journeys within a time interval

Tariffs - Spatial aspects: Terminology

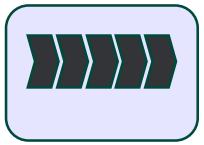
- **Flat** – There is only one price for the fare or product regardless of distance.



- **Point-to-point, Zone–to-Zone.** The fare gives the right to travel between two named stops. A discrete fare price can be given for each origin/destination pair.
  - Usually the fare prices increase progressively with increasing distance travelled, but the increase is not necessarily a strict linear function (further may be cheaper, and individual O/D prices may be adjusted arbitrarily to optimize yields, traffic, competitive advantage, etc).
  - Both Zone/Stage count and distance fares can be expressed as Z2Z/ P2P.



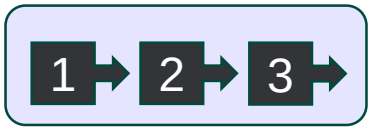
- **Named Zone(s):** The fare gives the right to travel in and between one or more identified zones. A fare price can be given for any allowed combination of zones.
  - If the zones are disjoint , then this is in effect “Zone to Zone” If the zones overlap or are nested then the topology is more complex, but still Z2Z.



- **Stage / Section count**. The fare gives the right to travel a certain **number** of sections or “stages” regardless of which specific sections they are. There is a price per zone used. The resulting fare prices are inherently progressive.

Tariffs - Spatial aspects: Exclude for now?

- **(Linear) Distance.** Fare prices are computed as a direct function of linear distance between stops. (usually actual mileage, but could be a notional “fare distance” or some arbitrary unit distance).
  - May be stepped intervals.
  - Note that distance fares can also be expressed as Z2Z/ P2P fares.
  - Not to be confused with Stage count.



- **Elements In Sequence.** Tariff prices vary or are limited according to the sequence of consumption of rights . E.g. Ticket allows Metro ride then bus ride but not bus ride then metro ride

- **Routing Constraints.** Tariff prices between the same origin and destination vary according to the route taken.
  - Mainly relevant for rail.
  - SERIES CONSTRAINTS Constraints can be described and priced separately

Department for Transport

More complex UK Bus fare products - Carnets: Multi-trip / Multi-pass offers

Access rights		Tariff Structures		
Type of Product	FARE PRODUCT (AMOUNT OF PRICE UNIT)	**Quantity**	**Related tariff structure**	**Temporal Conditions**
CARNET	***Multi-trip***	☑	Any individual Trip	Trips have use-by date Trips can be time limited
	Multi-Day pass	☑	Day Pass	Passes have specified duration Passes have use-by date

Department for Transport

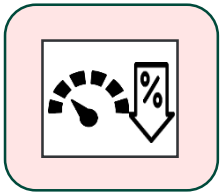
Additional Product Types - terminology

Discount Right

The product gives the right to purchase other fare products for travel at a discount, but is not itself a ticket. (e.g. Rail card, Oyster card).

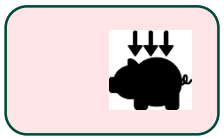
Capped Discount Right

If there are multiple purchases, the purchase price is capped within a given time period (e.g. Oyster Card)



Usage Discount

The product gives a discount or rebate based on access rights consumed within a given period. Requires an account.



Amount Of Price Unit

The product holds an amount of stored value which can be used to purchase. May be linked to an account.

Department for Transport

Complex UK Bus Fare Products
Discount cards, etc

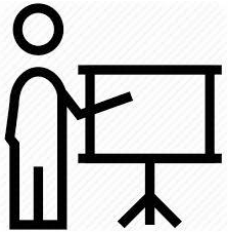
	FARE PRODUCT	Peak / Off Peak	(Can) or Must be Account Based	Notes
SALES DISCOUNT	SALES DISCOUNT RIGHT	☑	☑	E.g. like a Railcard
	CAPPED SALES DISCOUNT RIGHT	☑	☑	PAYG e.g. Oyster
USAGE DISCOUNT	USAGE DISCOUNT RIGHT	☑	☑	Rebate for use, e.g. mileage
STORED VALUE	AMOUNT OF PRICE UNIT	-	☑	Stored value
ENTITLING PRODUCT	THIRD PARTY PRODUCT	-	-	E.g. Military Pass

Department for Transport

Add-on UK Bus Fare Products
Not needed except for Coach?

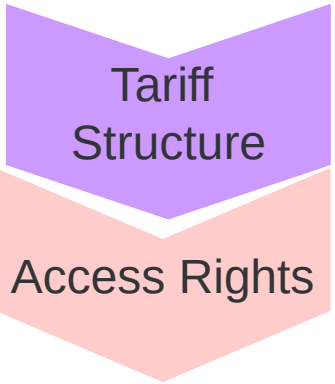
		Tariff Structure				
	FARE PRODUCT	Flat	Point to point	Named Zones	Peak / Off Peak	Notes
TRIP SUPPLEMENT	***Seat Reservation***	✓		-	-	If separate ticket needed
	Bicycle	✓	-	✓	✓	If extra ticket needed
	Animal	✓	-	✓	-	Size dependent?
	Excess Luggage	✓	-	-	-	If extra ticket needed
TRIP & PASS ADD ON	***Excursion***	✓	✓	✓	✓	Window of use
	Special Event	✓	✓	✓	✓	**Product Group** Event date

Department for Transport



Representing Tariff Spatial Structures in NeTEx

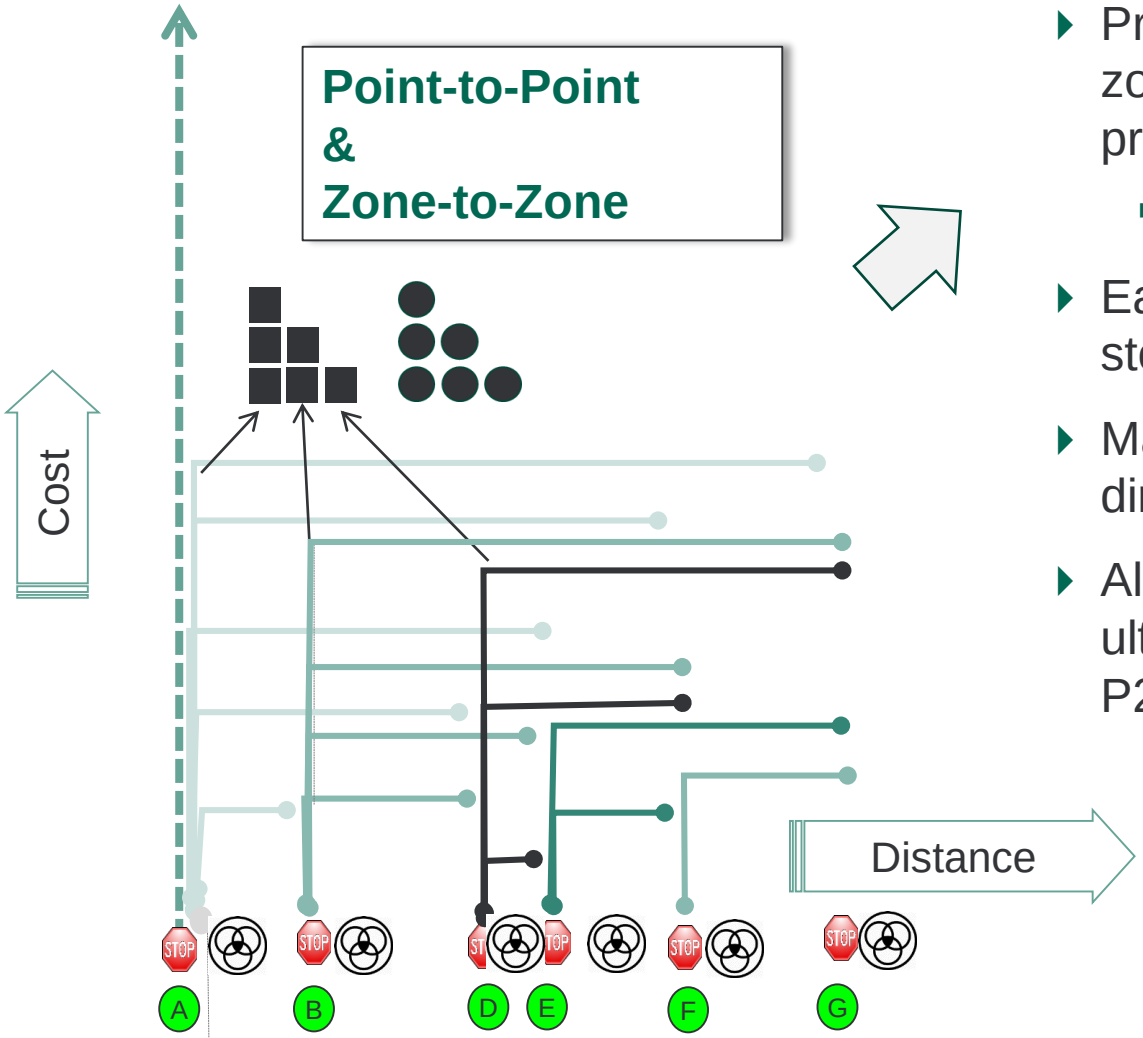
(with examples)



- Point-to-Point
- Zone
- Section Count
- Flat

Department for Transport

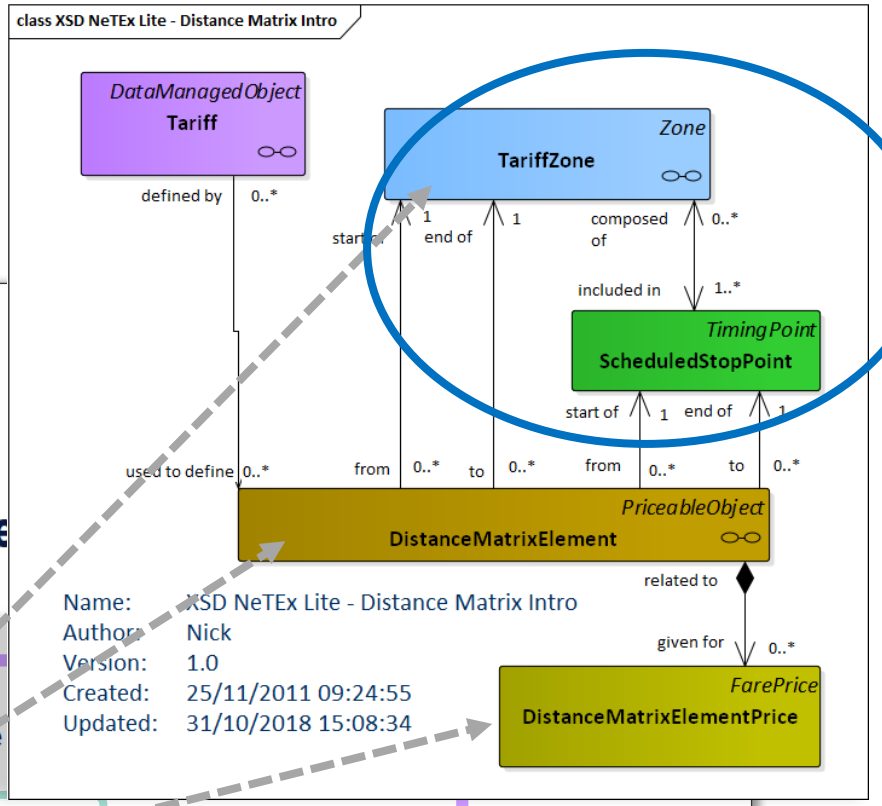
Point to Point Tariff structure

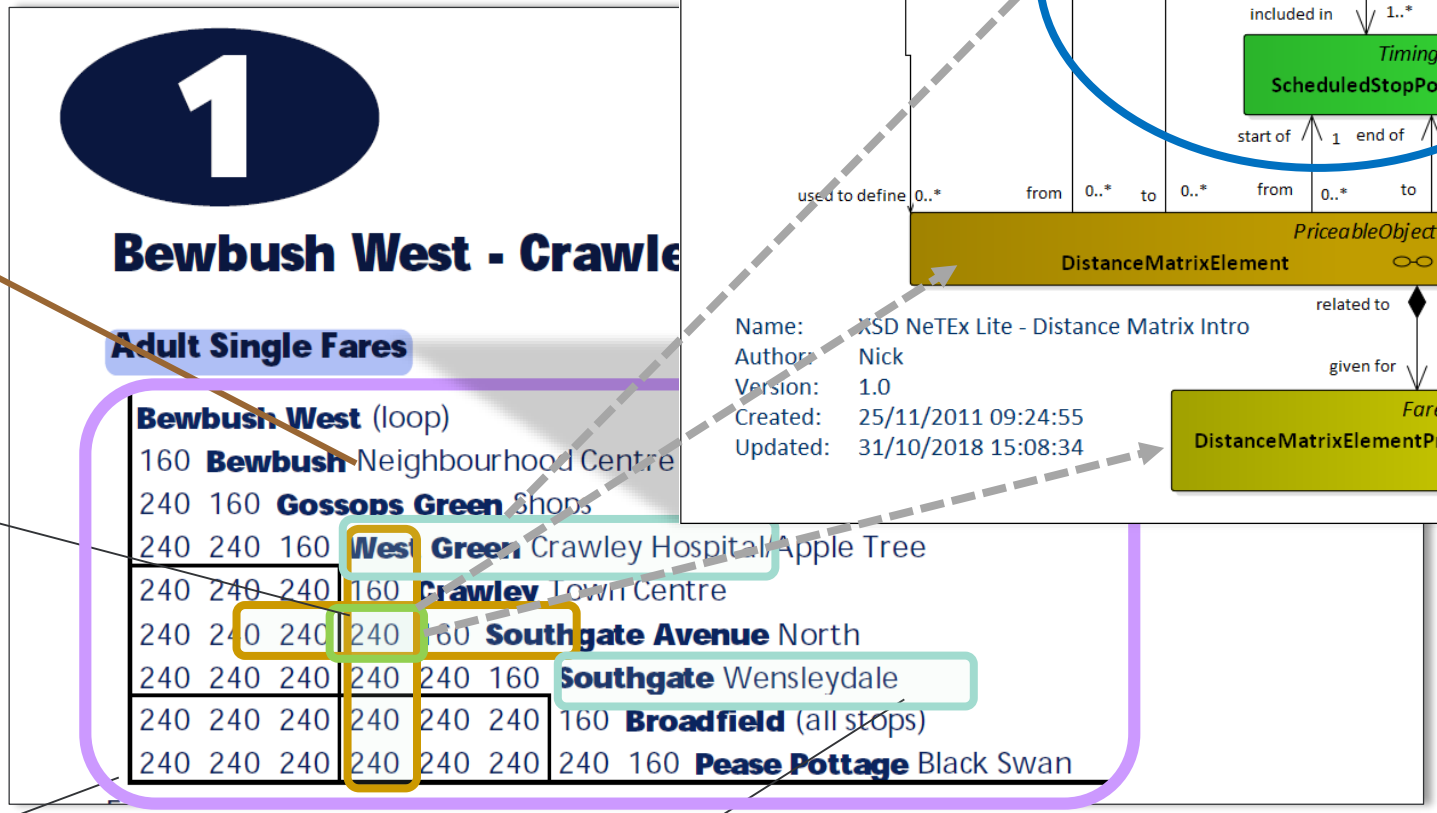


- Price between any two points (or zones) is arbitrary (though usually progressive)
  - May even be dynamic
- Each stop has 1-n prices to other n stops - Classic “Fare Triangle”
- May be different in opposite directions
- Almost any tariff structure can ultimately be presented as a set of P2P prices.

Department for Transport

A Distance Matrix



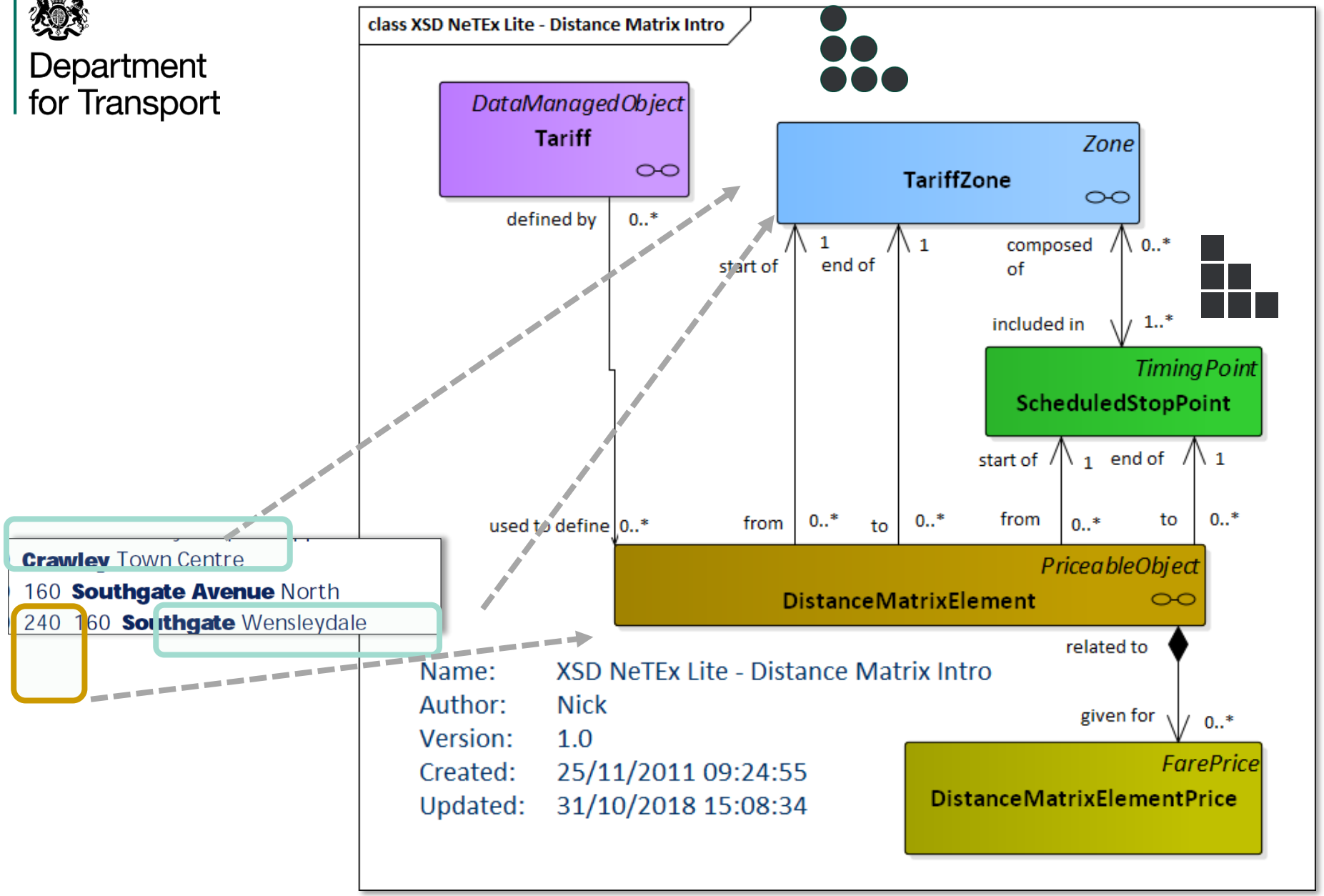


DISTANCE MATRIX ELEMENT

FARE PRICEs

TARIFF

TARIFF ZONEs


class XSD NeTEx Lite - Distance Matrix Intro
DataManagedObject
Tariff
Zone
TariffZone
defined by
0..*
start of
1
end of
1
composed of
0..*
included in
1..*
TimingPoint
ScheduledStopPoint
start of
1
end of
1
used to define
0..*
from
0..*
to
0..*
from
0..*
to
0..*
PriceableObject
DistanceMatrixElement
related to
given for
0..*
FarePrice
DistanceMatrixElementPrice
Crawley Town Centre
160 Southgate Avenue North
240 160 Southgate Wensleydale
Name: XSD NeTEx Lite - Distance Matrix Intro
Author: Nick
Version: 1.0
Created: 25/11/2011 09:24:55
Updated: 31/10/2018 15:08:34

Department for Transport

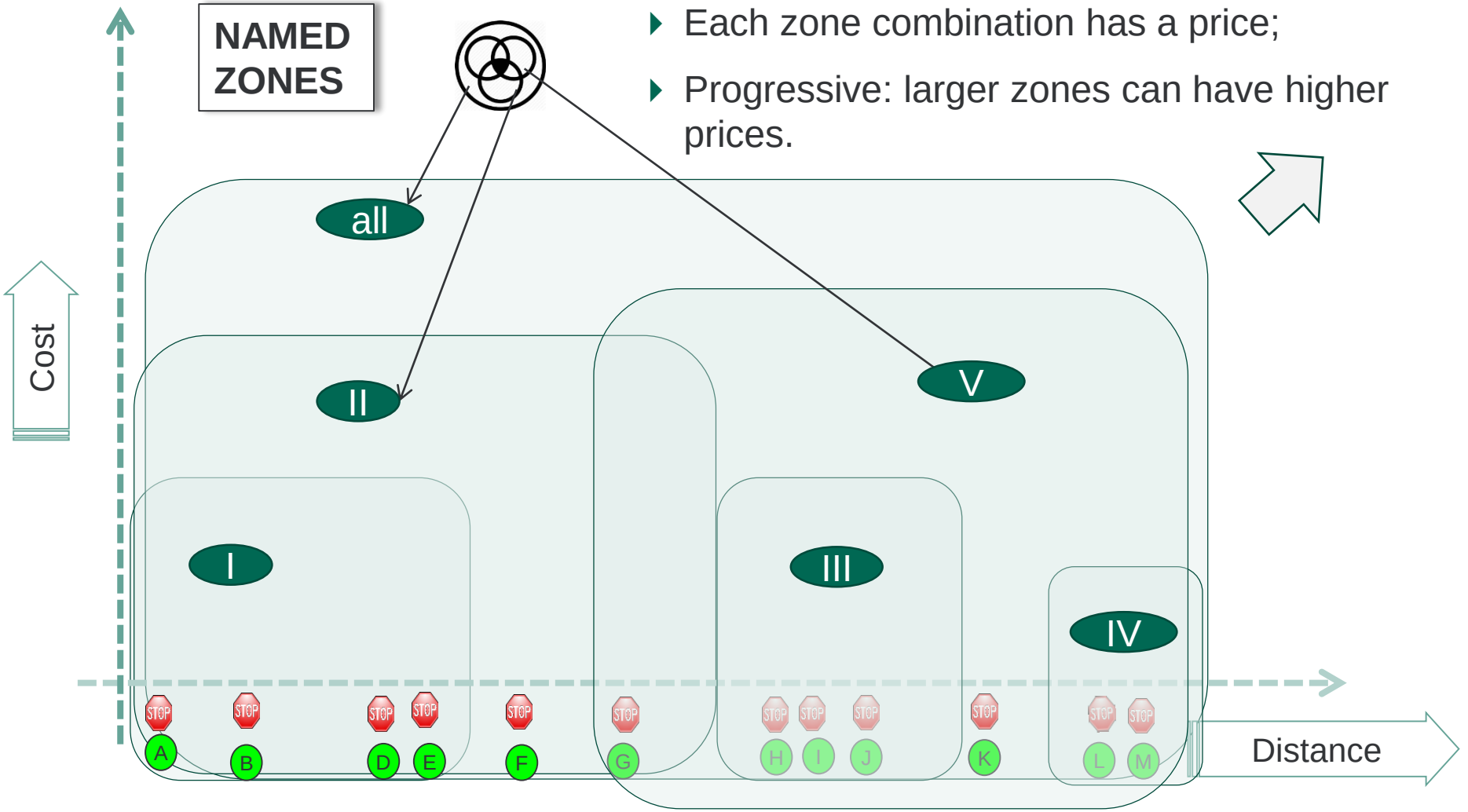
DISTANCE MATRIX ELEMENT - Notes

- DISTANCE MATRIX specifies in effect a table of Origin/Destination (O/D) pairs
  - DISTANCE MATRIX ELEMENT can be P2P (SCHEDULED STOP POINT) or Z2Z (TARIFF ZONE / FARE ZONE). Is P2Z also found?
  - The same DISTANCE MATRIX ELEMENT can be reused for many different products & fare combinations (adult, child, etc).
- FARE PRICEs can be associated with each DISTANCE MATRIX ELEMENT *or further combinations of it with other factors*
  - Prices can be absolute or derived
  - Prices can be based on price bands
- Advanced Comments
  - We can have reusable GROUPS OF DISTANCE MATRIX ELEMENTs
  - We can have multiple routings (SERIES CONSTRAINTs) for the same element.

Department for Transport

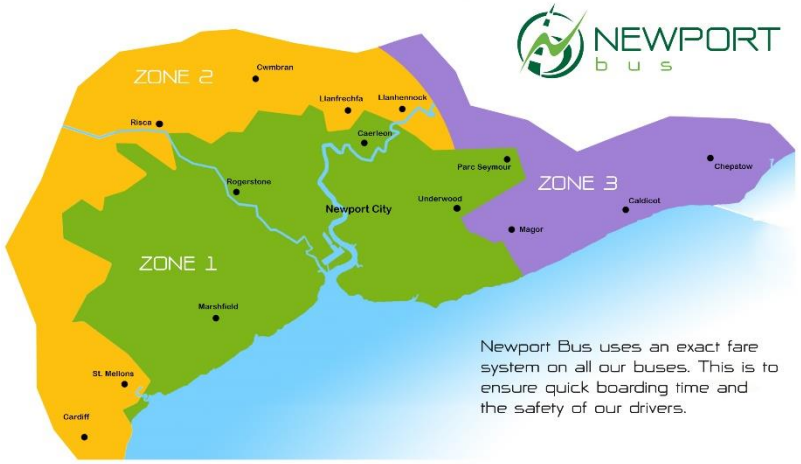
Zonal Tariff

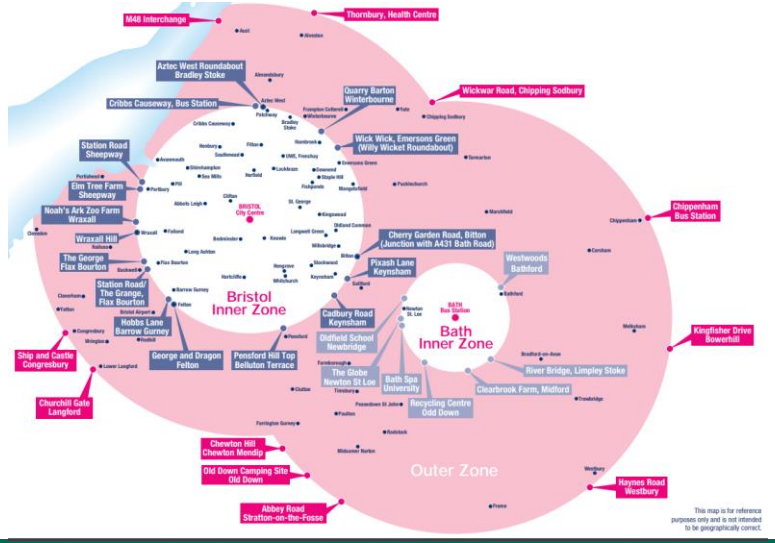
- Any stop may be in one or more zones.
- Zones may be nested, partially overlap, or disjoint (honeycomb)
- Each zone combination has a price;
- Progressive: larger zones can have higher prices.

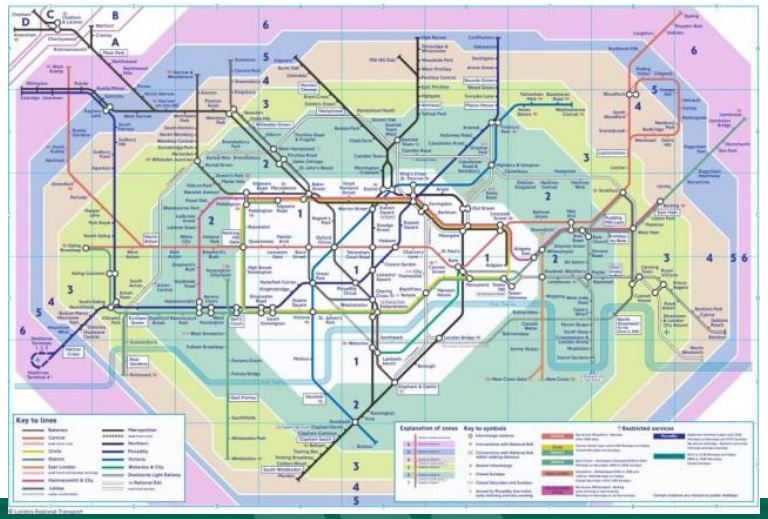


Department for Transport

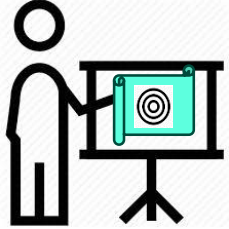
Zone topologies – Disjoint, nested, overlapping, doughnut etc…

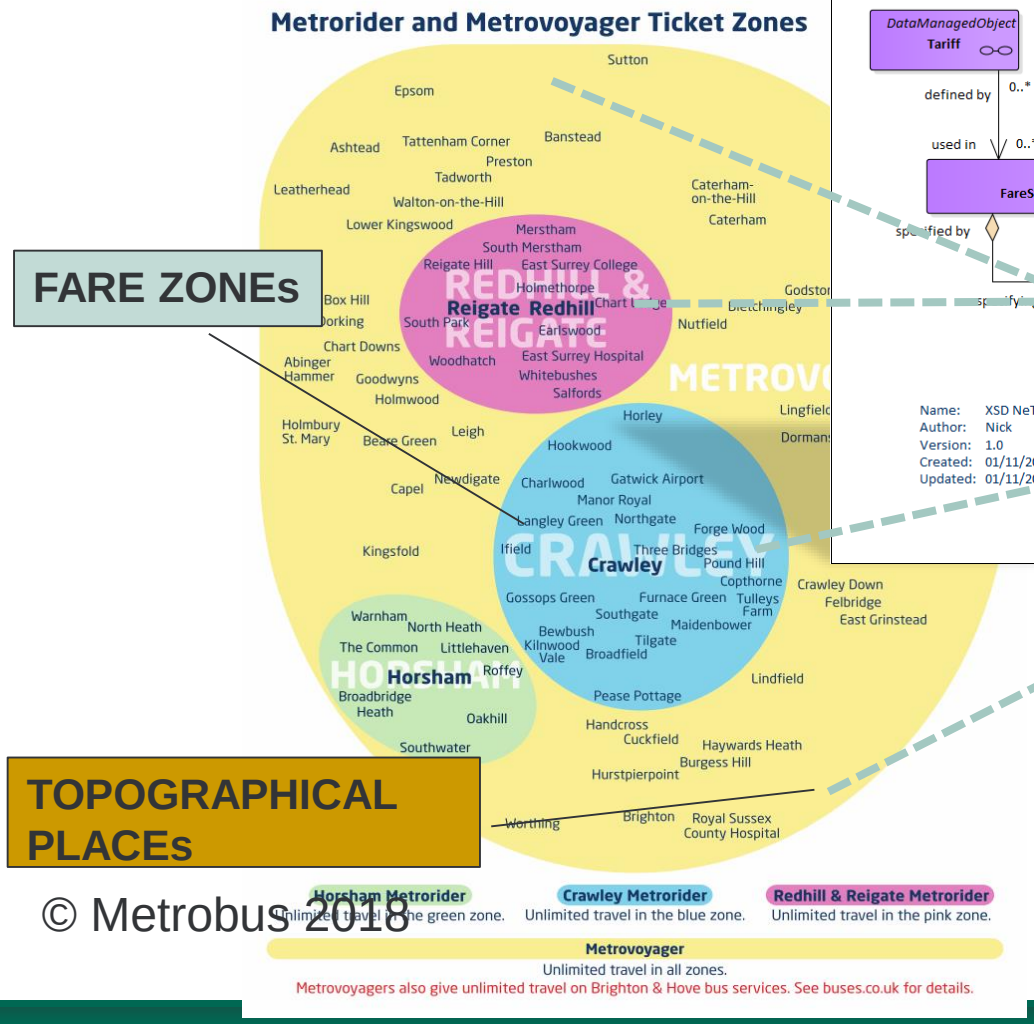


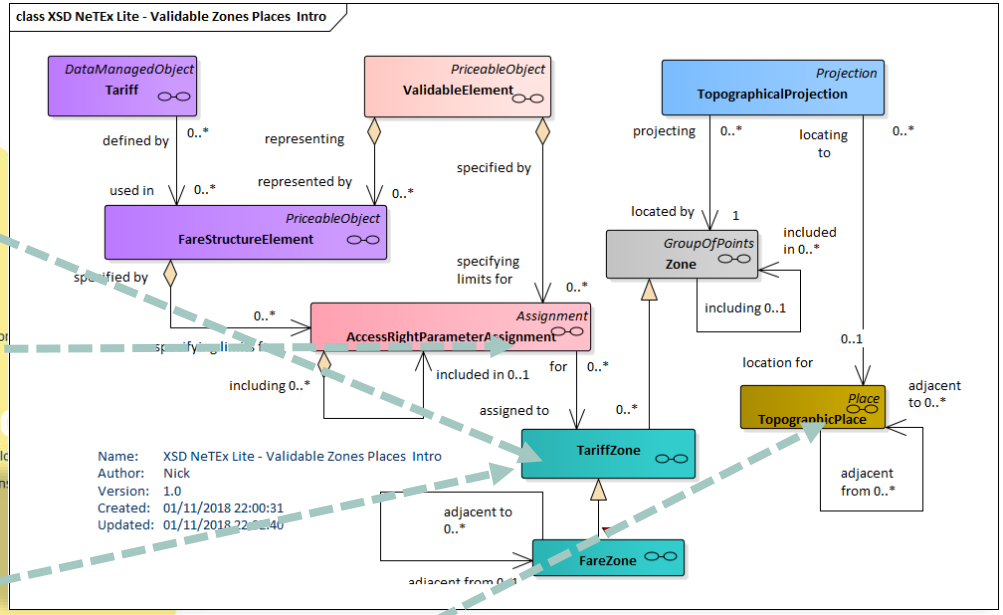




Nested Fare Zones - Metrorider &







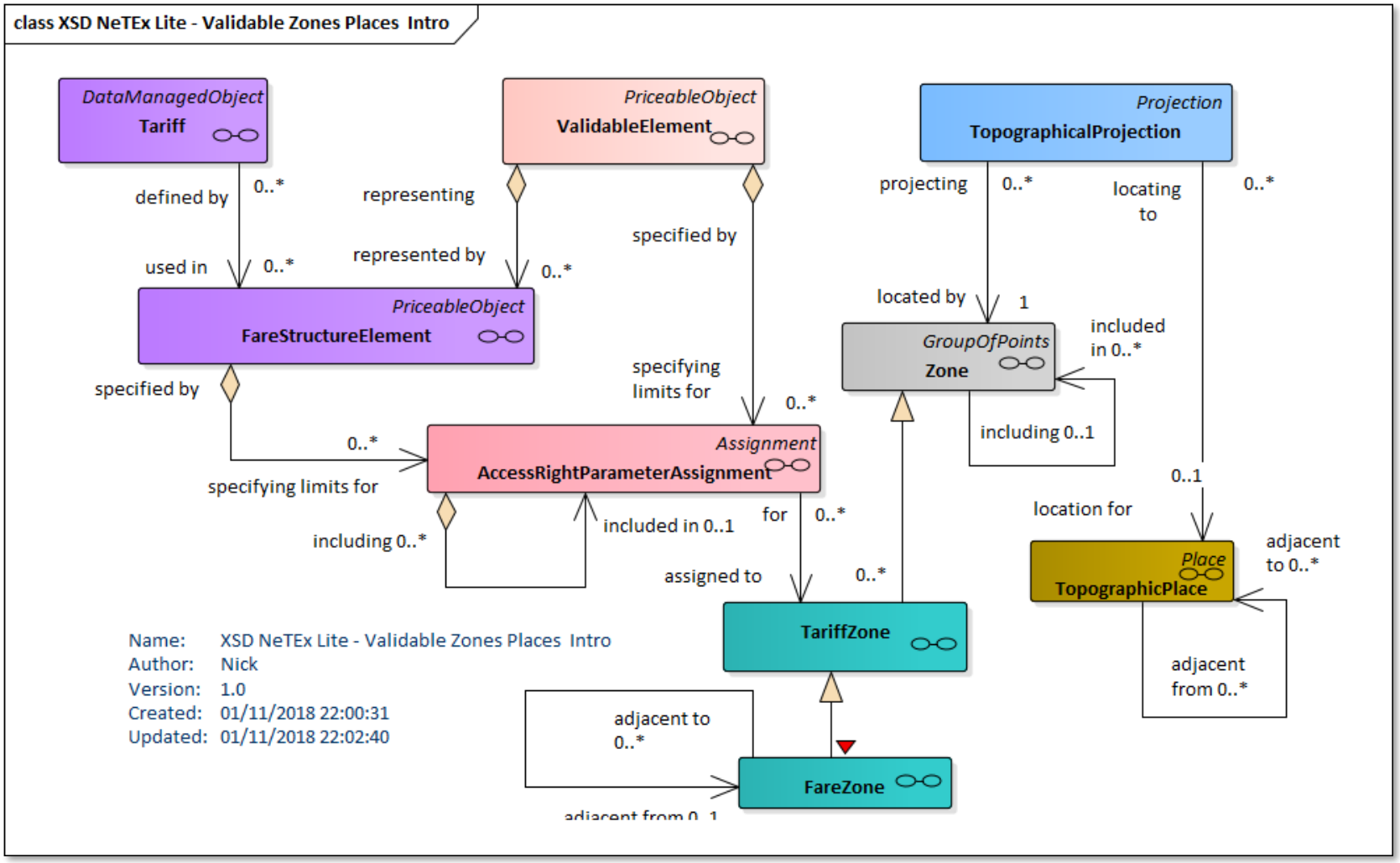
FARE ZONEs

TOPOGRAPHICAL PLACEs

- Sets of individual zones can be assigned as fare structure elements
- Zones can relate to stops
- Zones can be nested.

Department for Transport

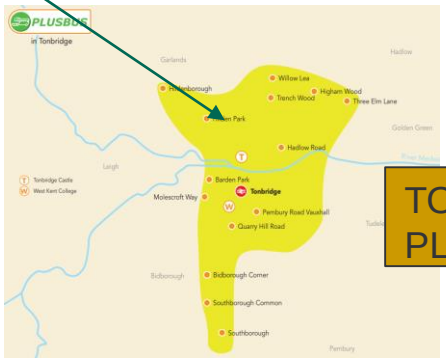
Named Zones



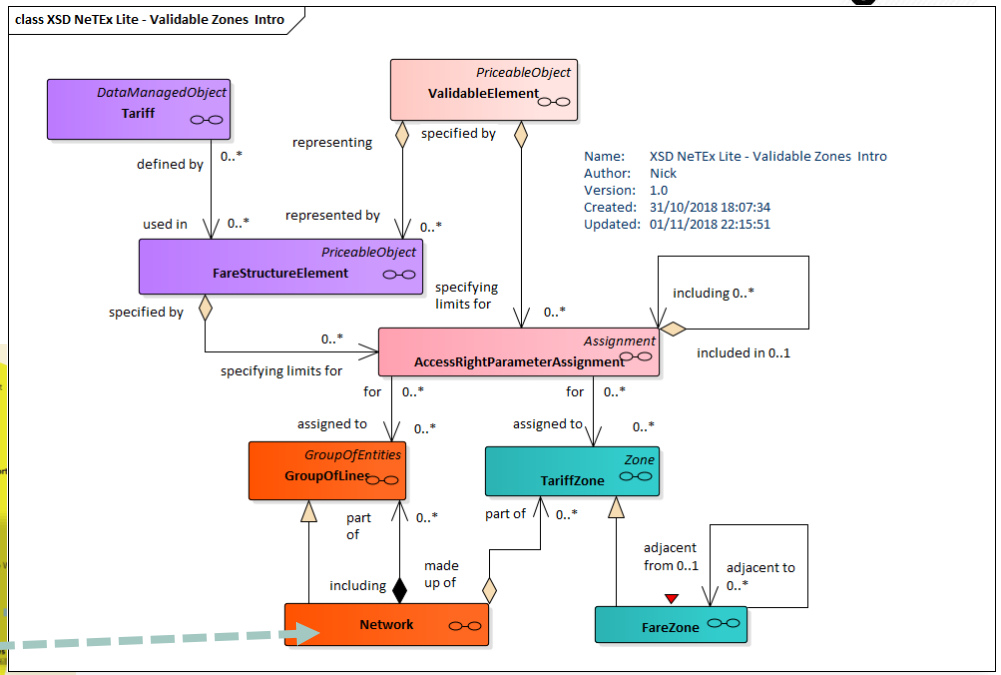
Department for Transport

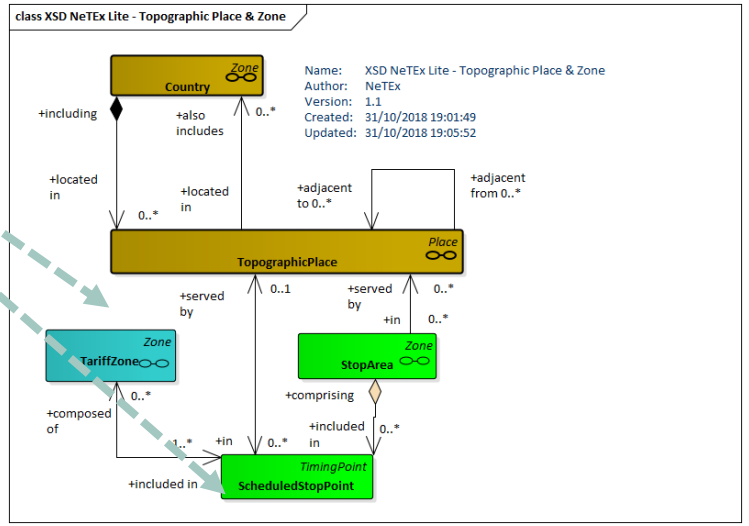
Named Zones - e.g. Plusbus

FARE ZONEs



TOPOGRAPHIC PLACEs





Department for Transport

Named Zones in fare structure -XML Code Snippet

- Fare Structure lists all zones
- User specifies which ones on purchase

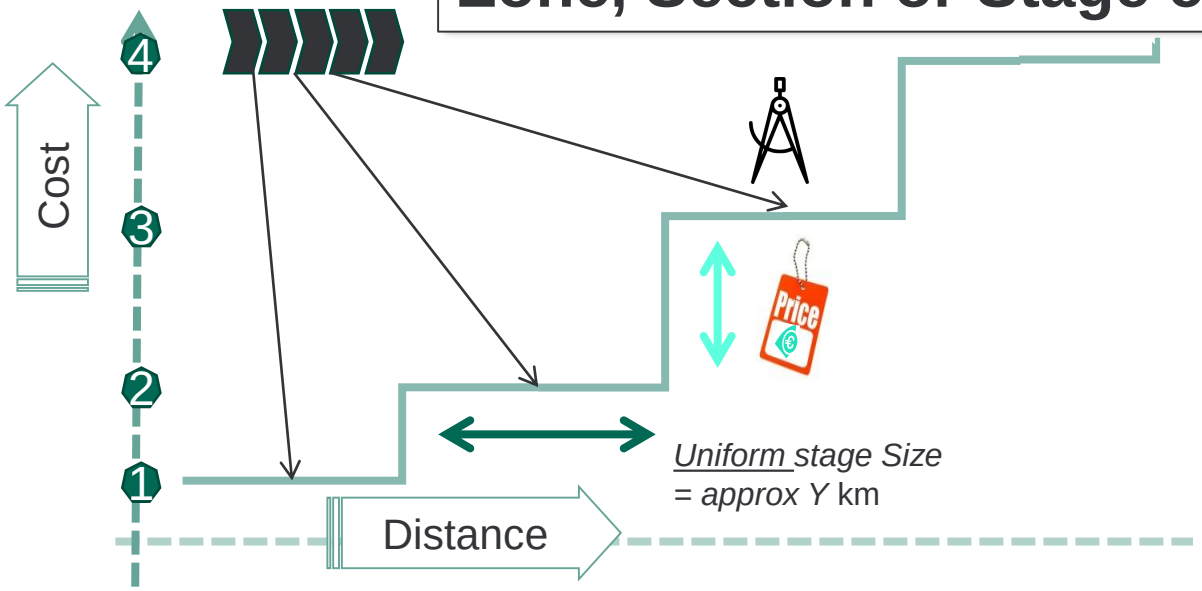
```
<Network version="01" id="jsp:PlusBus@Zones">
    <Name>Plusbus Network</Name>
    <OperatorRef version="1.0" ref="jsp:JSP"/>
    <tariffZones>
        <TariffZoneRef version="01" ref="nptg:PlusBus_zone:CRAWLEY"/>
        <TariffZoneRef version="01" ref="nptg:PlusBus_zone:IPSWICH"/>
……. Etc rest of zones
    </tariffZones>
```

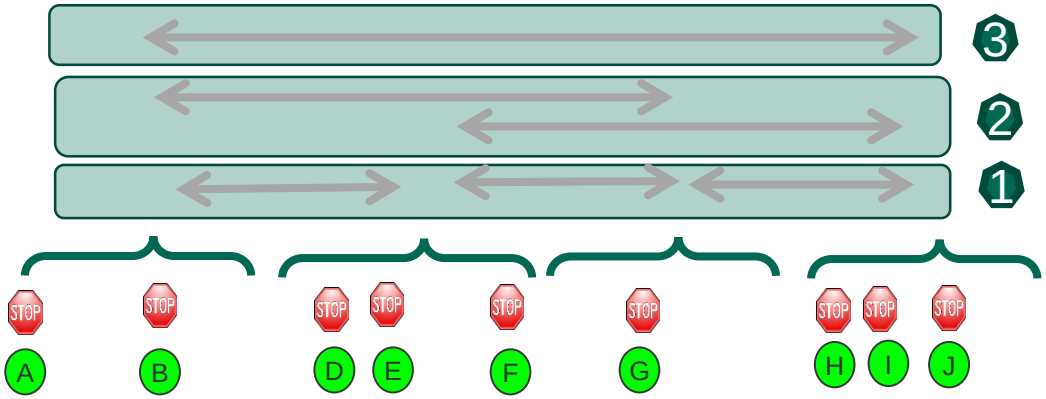
```
<FareStructureElement version="01" id="jsp:Pass@PlusBus@1zone">
    <Name>Plusbus single zone</Name>
        <validityParameterAssignments>
        <GenericParameterAssignment version="01" id="jsp:Pass@PlusBus@1zone" order="1">
            <TypeOfAccessRightAssignmentRef ref="jsp:can_access" version="any"/>
            <ValidityParameterGroupingType>OR</ValidityParameterGroupingType>
            <validityParameters>
                <NetworkRef ref="nptg:PlusBus_zones"/>
            </validityParameters>
        <v/alidityParameterAssignments>
```

Stage / Section Count Tariff

Department for Transport

Zone, Section or Stage count





- Stops allocated to similar sized sections.
- A section is delimited by a start and end point within a journey pattern
- Fare price is for one or more sections
- Price may be uniform for every section, or progressive for ranges of sections.
- A section can also be regarded as a 2D zone containing stops,

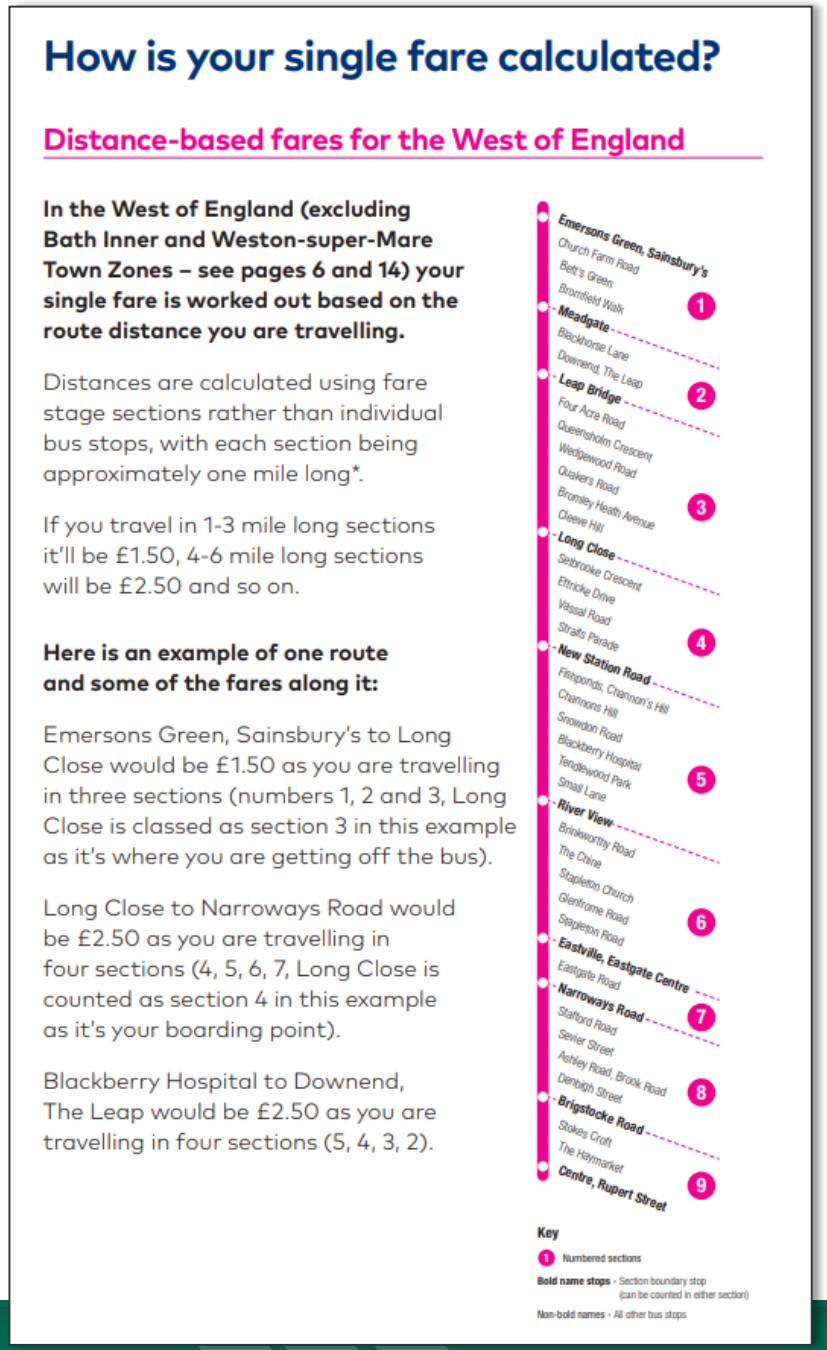
Department for Transport

Stage /Section Count Fares

First

Does not matter which section, just the number of sections.

x1 = £1.50
x2 = £1.50
x3 = £1.50
x4 = £2.50
x5 = £2.50
x6 = £2.50
x7 = £4.50
x8 = £4.50
x9 = £4.50
x10 = £5.50
X11 = £5.50
X12 = £5.50



How is your single fare calculated?

Distance-based fares for the West of England

In the West of England (excluding Bath Inner and Weston-super-Mare Town Zones – see pages 6 and 14) your single fare is worked out based on the route distance you are travelling.

Distances are calculated using fare stage sections rather than individual bus stops, with each section being approximately one mile long*.

If you travel in 1-3 mile long sections it'll be £1.50, 4-6 mile long sections will be £2.50 and so on.

Here is an example of one route and some of the fares along it:

Emersons Green, Sainsbury's to Long Close would be £1.50 as you are travelling in three sections (numbers 1, 2 and 3, Long Close is classed as section 3 in this example as it's where you are getting off the bus).

Long Close to Narroways Road would be £2.50 as you are travelling in four sections (4, 5, 6, 7, Long Close is counted as section 4 in this example as it's your boarding point).

Blackberry Hospital to Downend, The Leap would be £2.50 as you are travelling in four sections (5, 4, 3, 2).

Department for Transport

Stage Fares

First

GEOGRAPHIC UNIT
1-Section

GEOGRAPHIC INTERVALS

❶ ❷ ❸

01-03	= £1.50
04-06	= £2.50
07-09	= £4.50
10+	= £5.50

FARE PRICEs

How is your single fare calculated?

Distance-based fares for the West of England

In the West of England (excluding Bath Inner and Weston-super-Mare Town Zones – see pages 6 and 14) your single fare is worked out based on the route distance you are travelling.

Distances are calculated using fare stage sections rather than individual bus stops, with each section being approximately one mile long*.

If you travel in 1-3 mile long sections it'll be £1.50, 4-6 mile long sections will be £2.50 and so on.

Here is an example of one route and some of the fares along it:

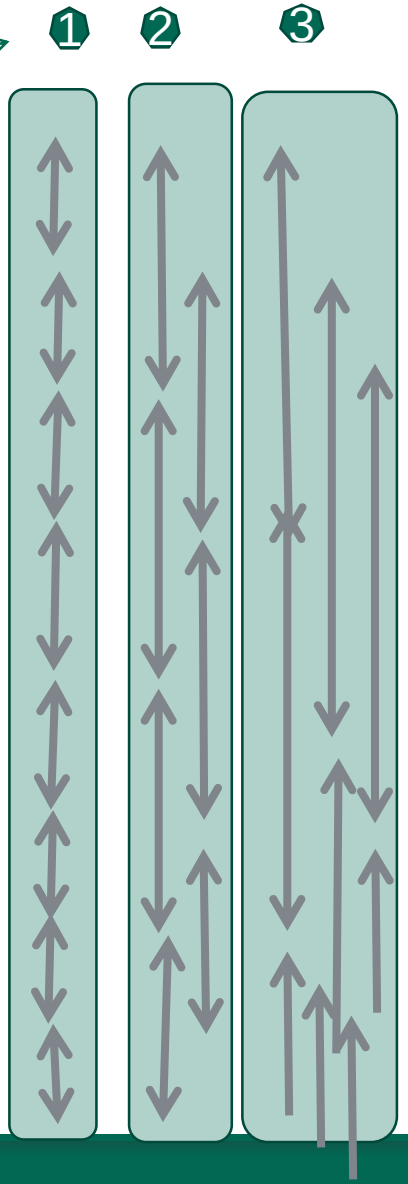
Emersons Green, Sainsbury's to Long Close would be £1.50 as you are travelling in three sections (numbers 1, 2 and 3, Long Close is classed as section 3 in this example as it's where you are getting off the bus).

Long Close to Narroways Road would be £2.50 as you are travelling in four sections (4, 5, 6, 7, Long Close is counted as section 4 in this example as it's your boarding point).

Blackberry Hospital to Downend, The Leap would be £2.50 as you are travelling in four sections (5, 4, 3, 2).

FARE SECTIONs

SCHEDULED STOP POINTs



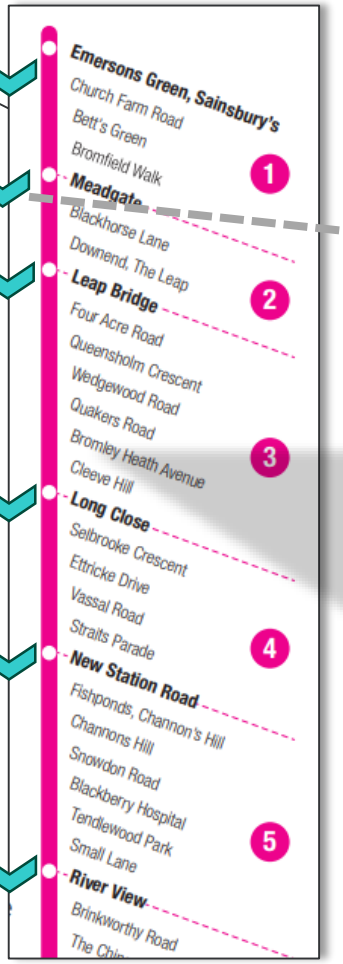
Modelling – Stage definitions

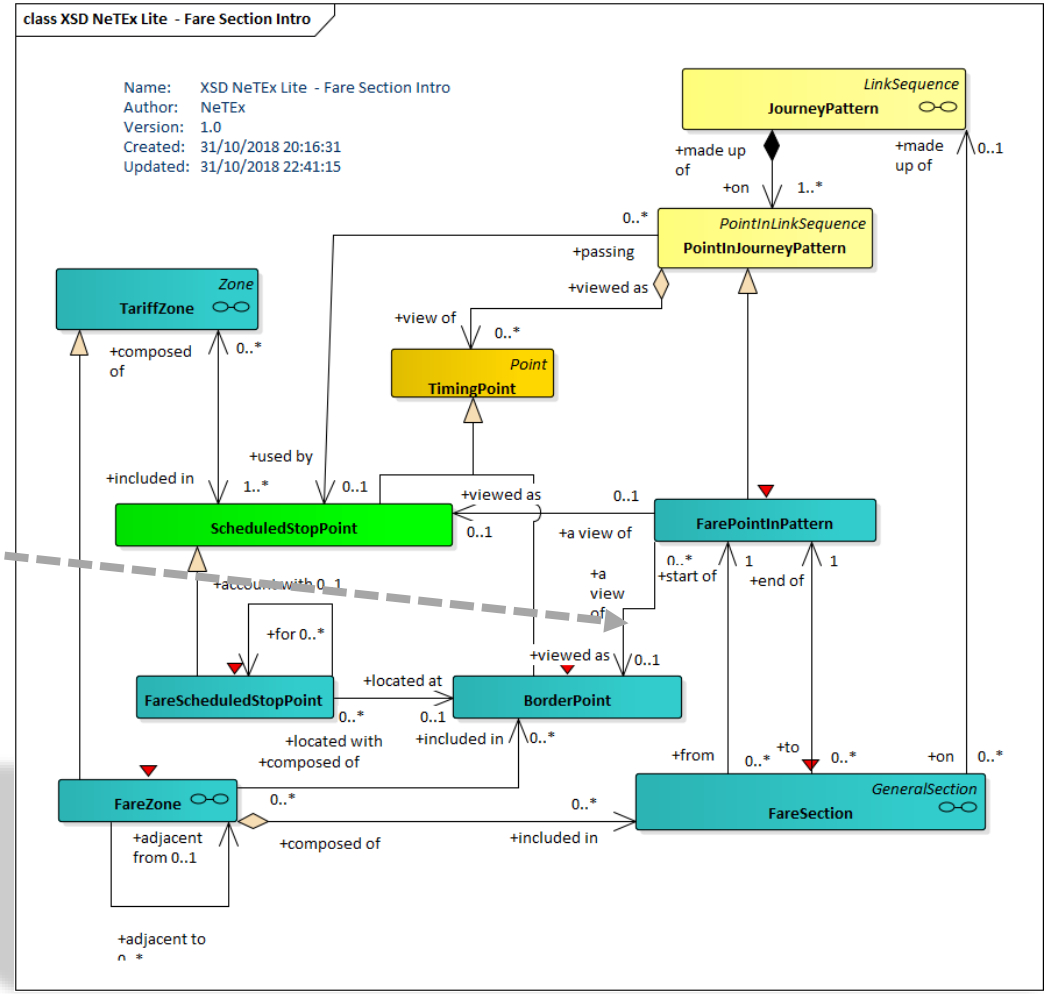
Department for Transport

SCHEDULED STOP POINTs

FARE POINT IN PATTERN

FARE SECTIONs





- Dynamic zone counting : Trip planner uses JOURNEY PATTERN to determine number of FARE SECTIONs traversed between origin and destination POINT IN PATTERN

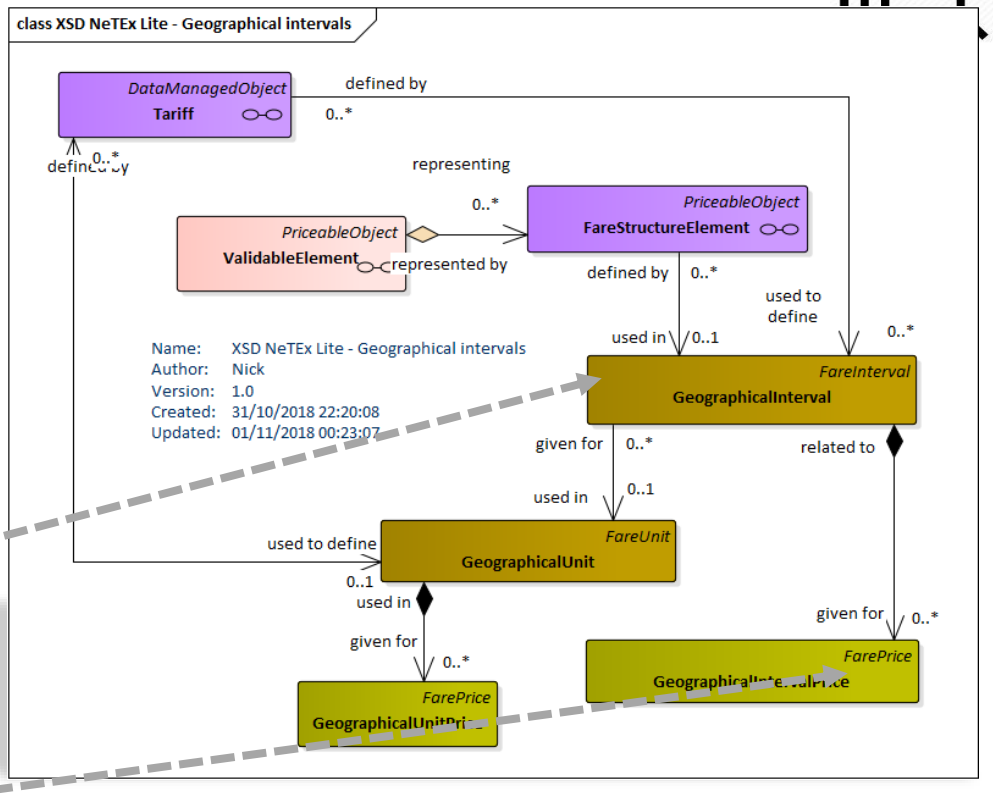
Department for Transport

First

Modelling Stage Fare Unit prices

GEOGRAPHIC UNIT = a Section

GEOGRAPHIC INTERVAL



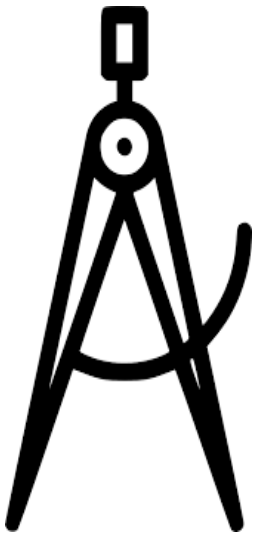
id	Start	End	➔Price
001	01	03	£1.50
002	04	06	£2.50
003	07	09	£4.50
004	10		£5.50

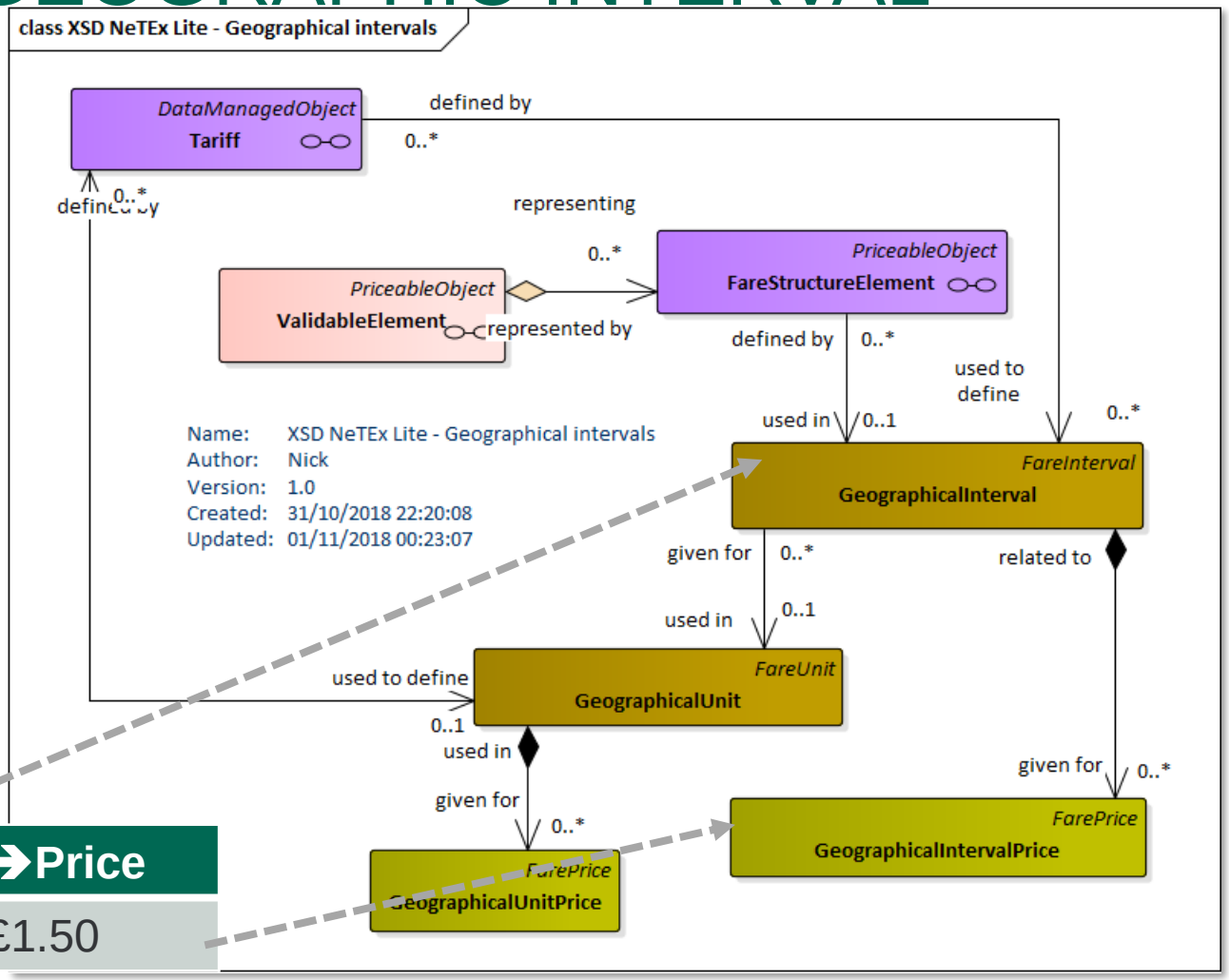
- Price may be uniform for every section (PRICE UNIT PRICE) , or progressive for ranges of sections PRICE INTERVAL PRICE).

GEOGRAPHICAL INTERVAL_PRICE

Department for Transport

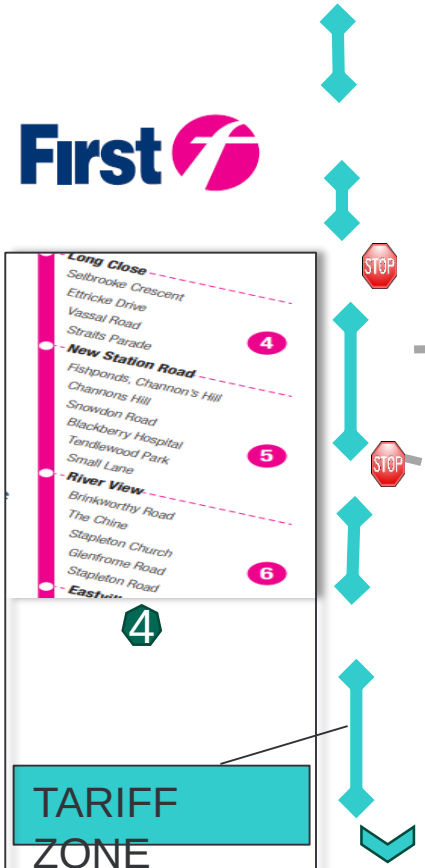
Representing the Available units – GEOGRAPHIC INTERVAL

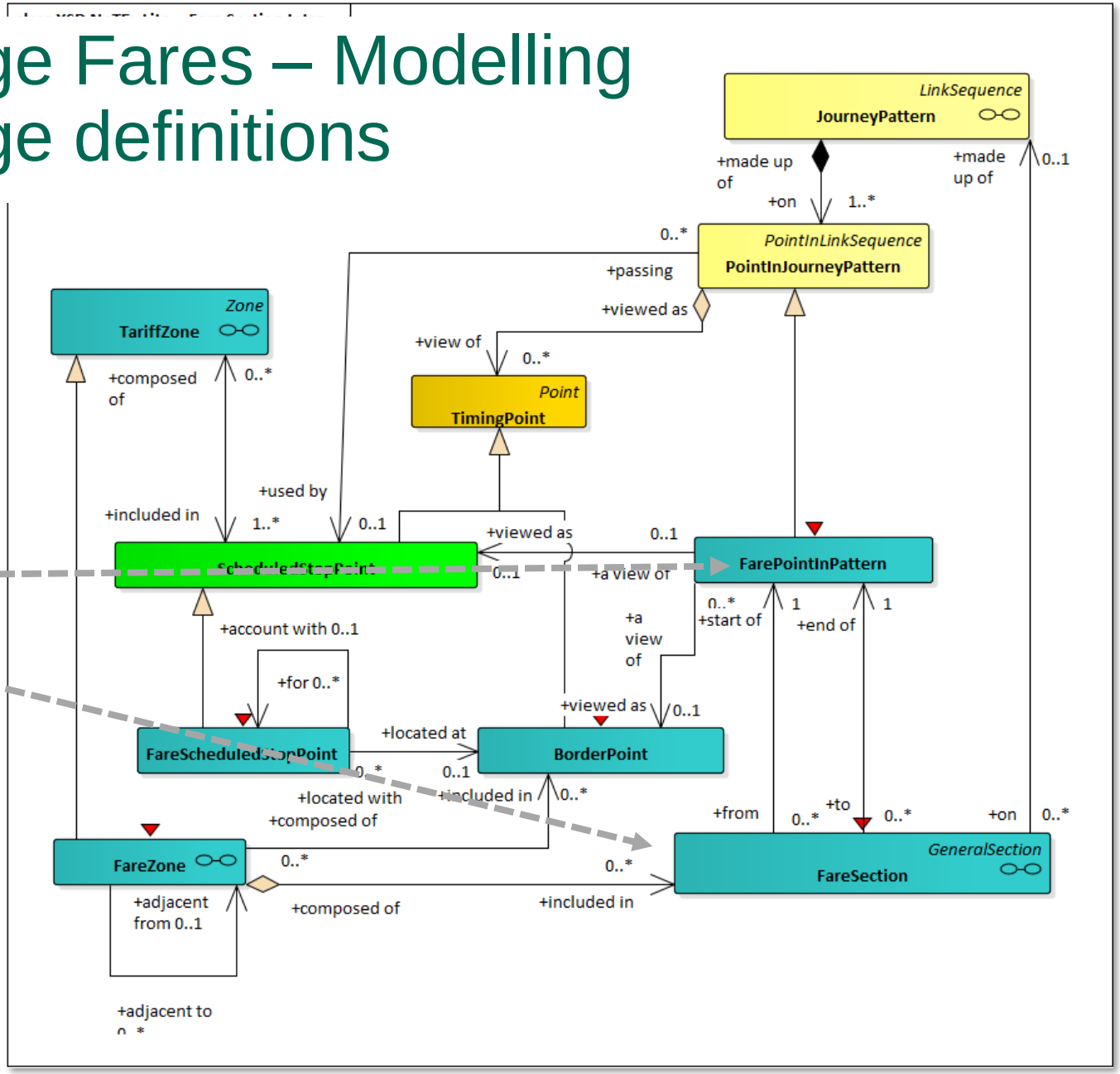




id	Start	End	→Price
001	01	03	£1.50

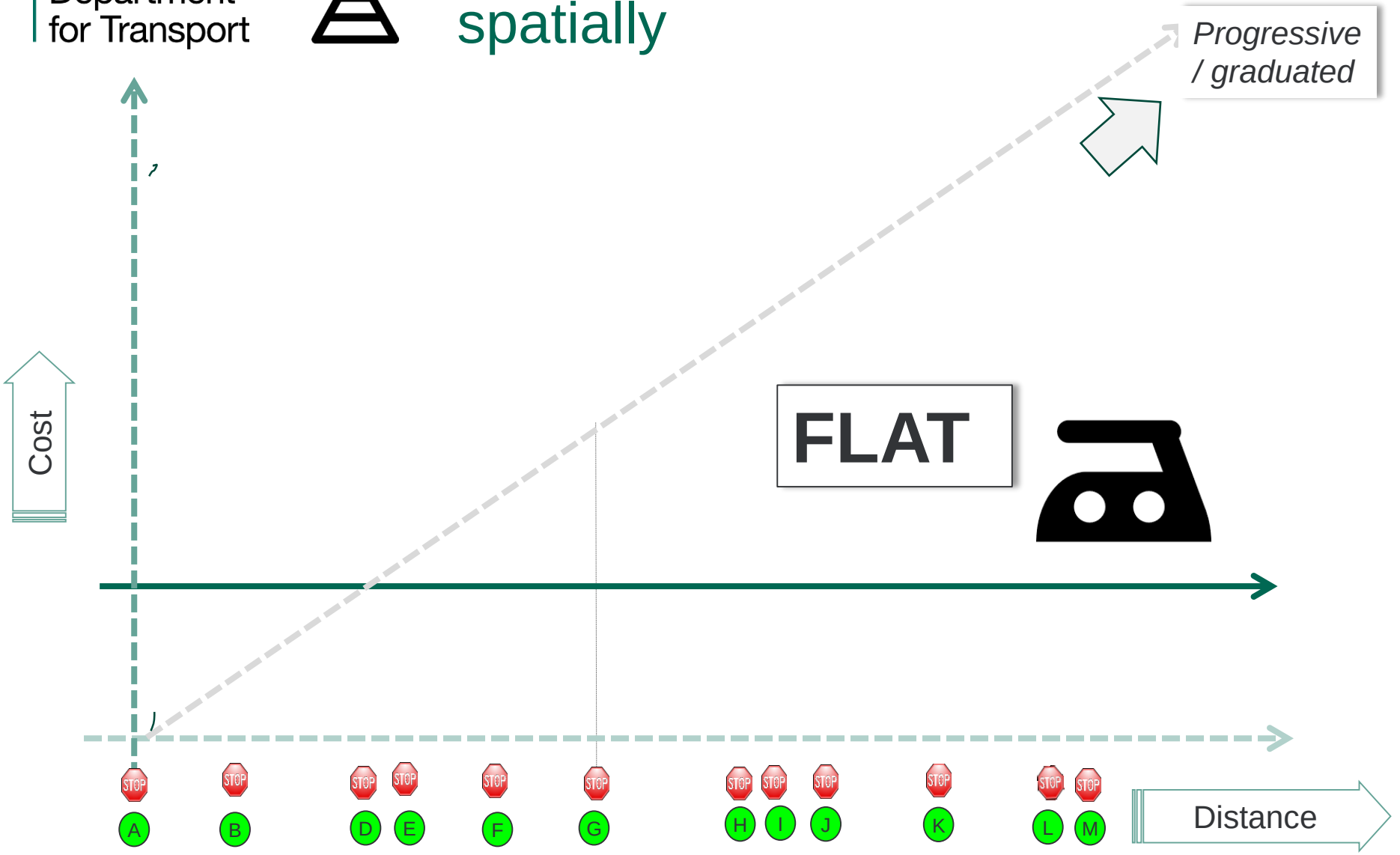
Stage Fares – Modelling Stage definitions





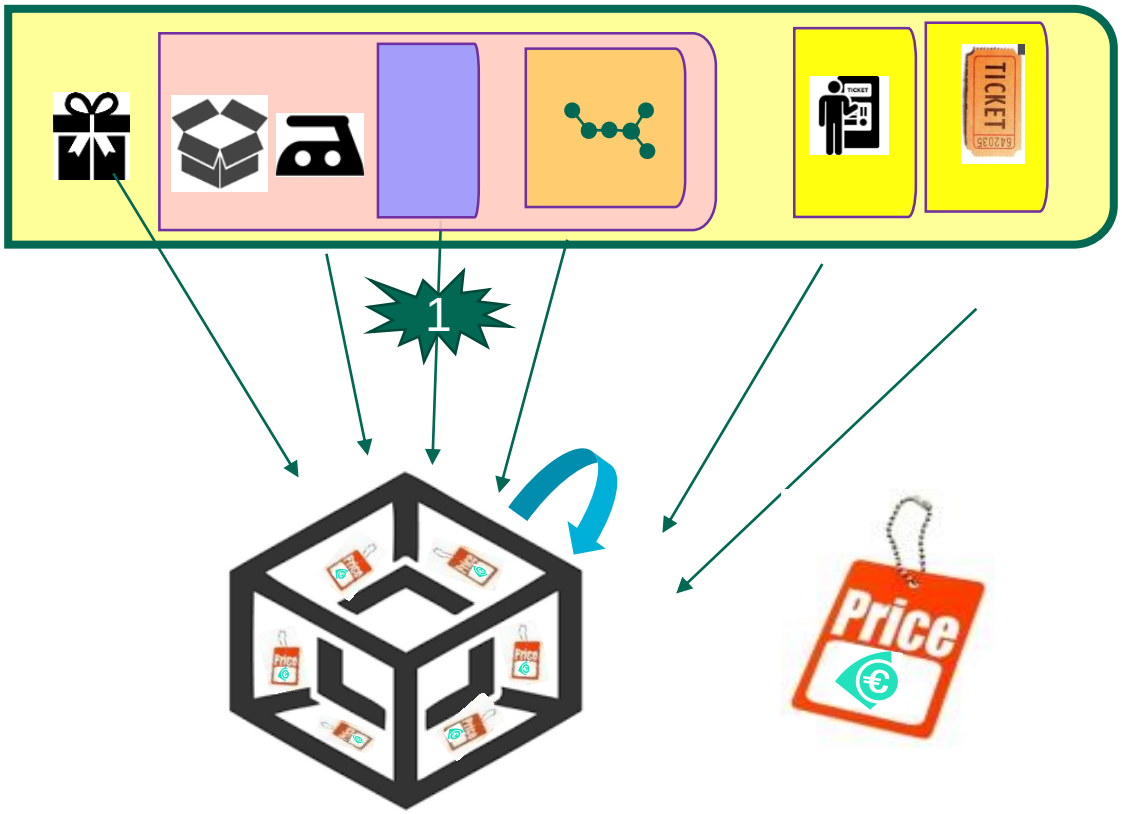
Department for Transport

Flat tariff – not progressive spatially



Department for Transport

Flat – Only one tariff price dimension, but any tariff structure element can be used for that dimension!

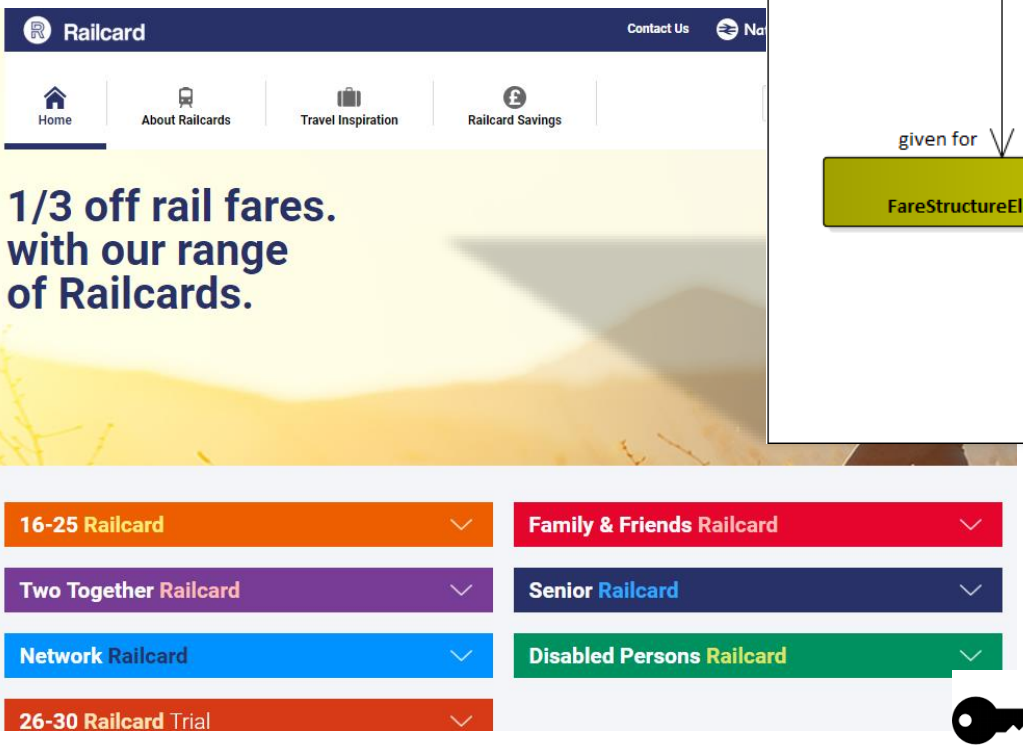


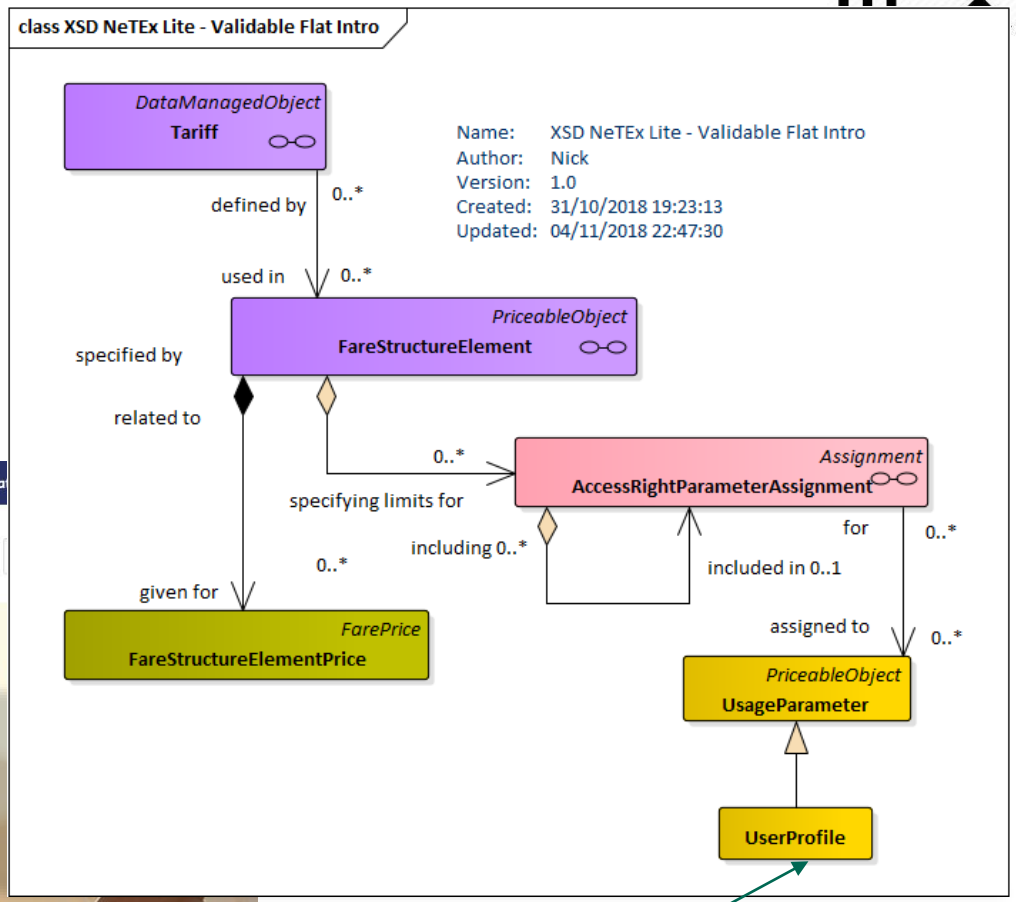
- *Flat* = Non-progressive fare structure (spatially or temporally)
  - E.g. Single product, railcard, bicycle ticket etc
  - E.g. Single zone
- A “flat” fare may still may have other price dimensions
  - E.g. separate adult & child fare prices

Department for Transport

Flat Rate tariff Example

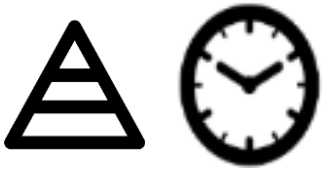
- Railcard priced by user type.

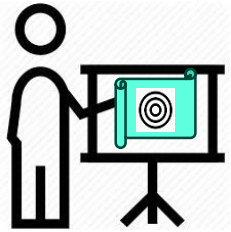




USER PROFILEs

Department for Transport





Representing Tariff Temporal Structures & Products in NeTEx (with examples)

- Time Intervals
- Validity Periods
- Fare Demand Periods

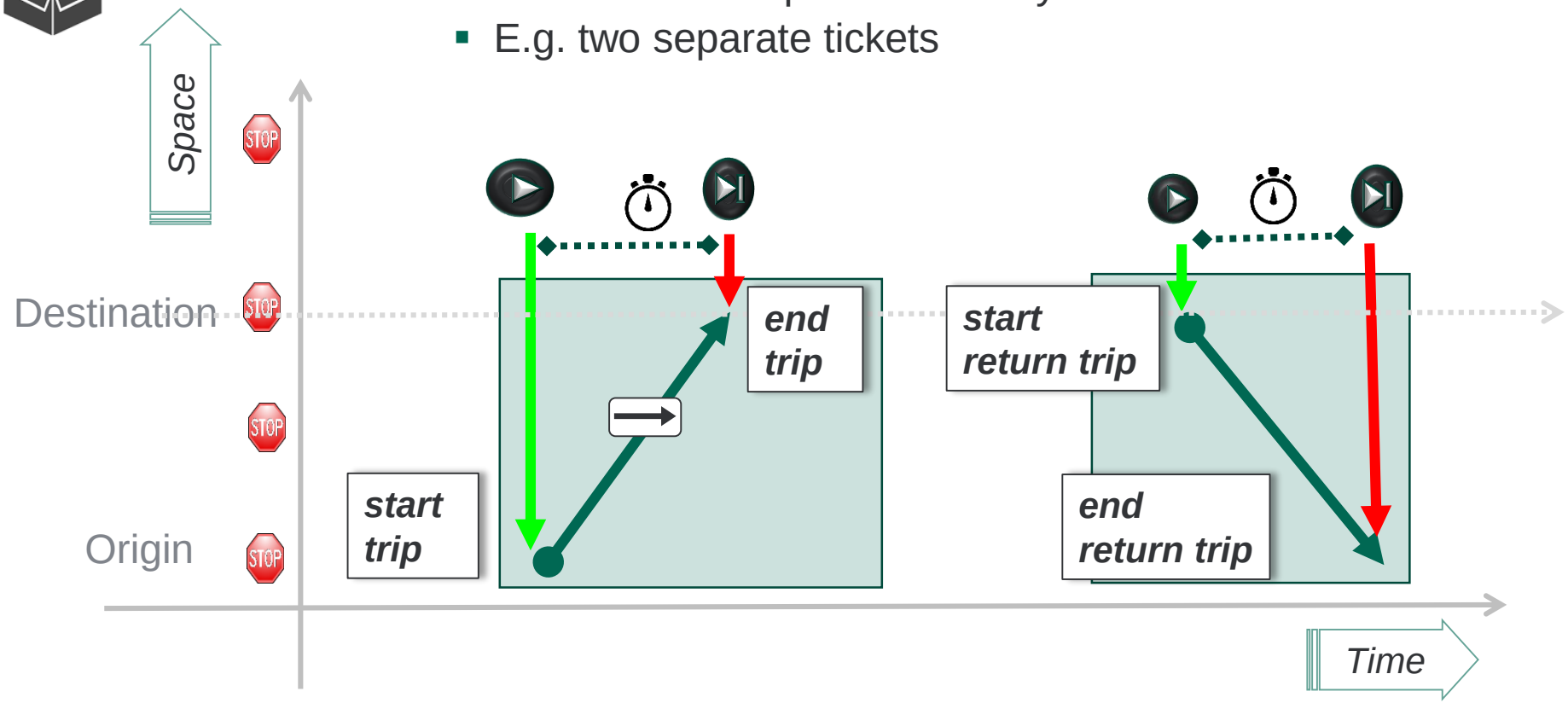
Tariff Structure

Access Rights

Department for Transport

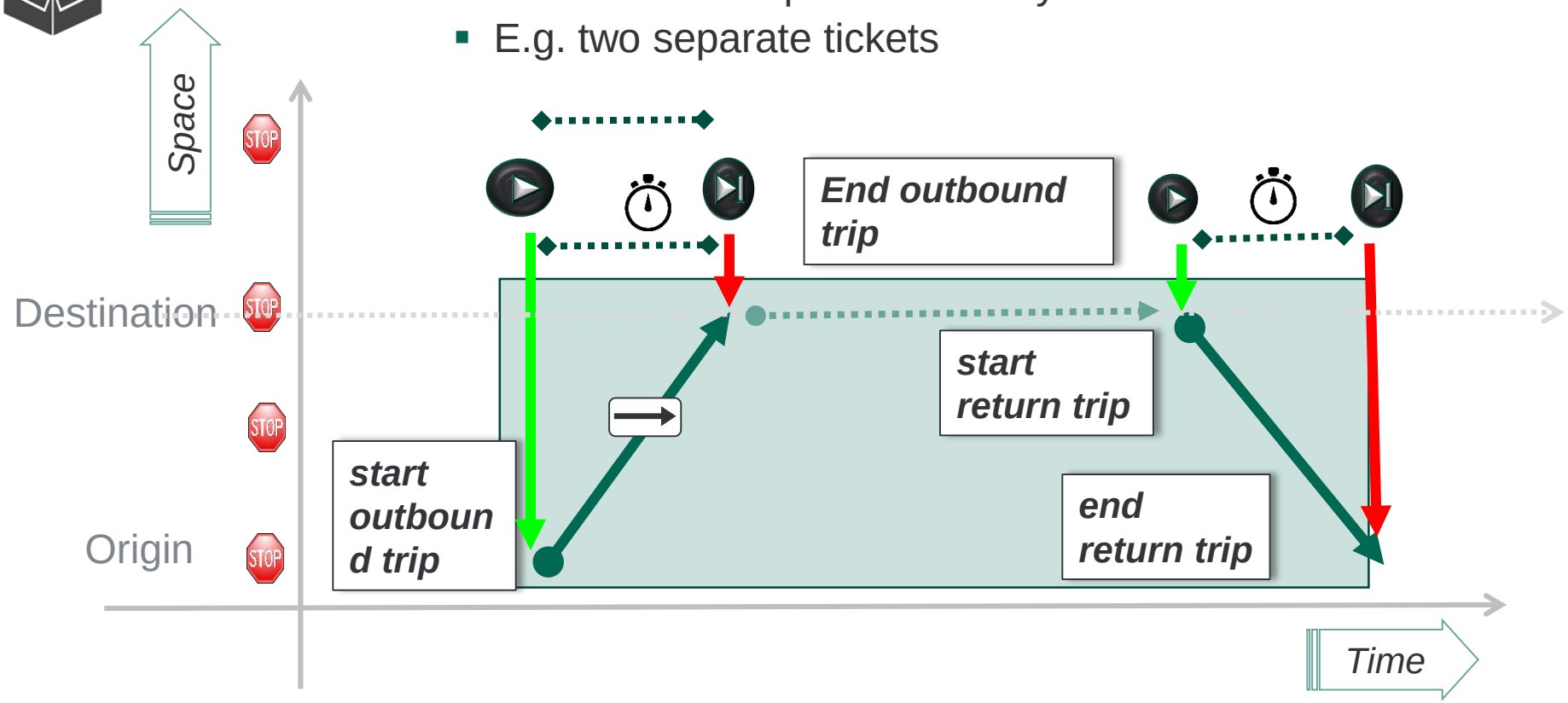
Visualising Time – Individual Trips

- We can visualise trips as lines in space time, made within the boundaries of a product validity
  - E.g. two separate tickets



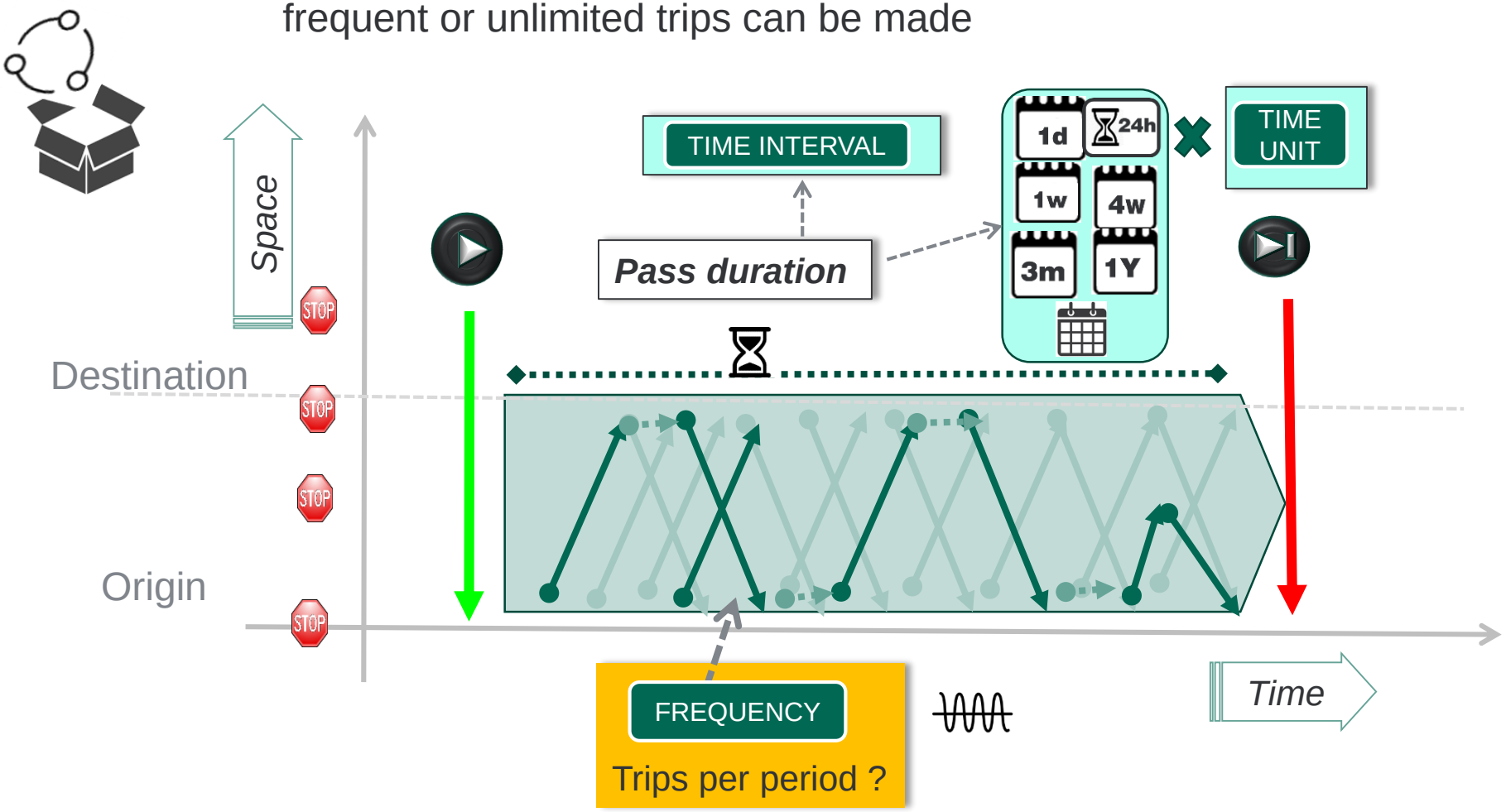
Visualising Time – A Period return trip

- We can visualise trips as lines in space time, made within the boundaries of a product validity
  - E.g. two separate tickets



Visualising Time – Passes

- We can visualise passes as bands in space time within which frequent or unlimited trips can be made

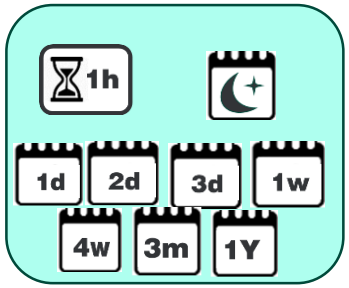


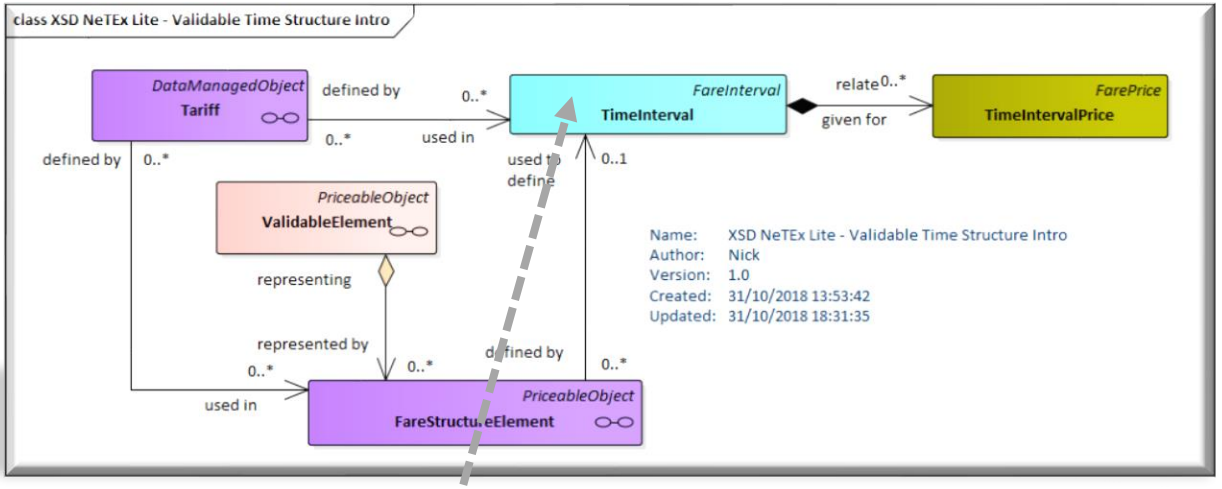
Department for Transport

1. Time intervals

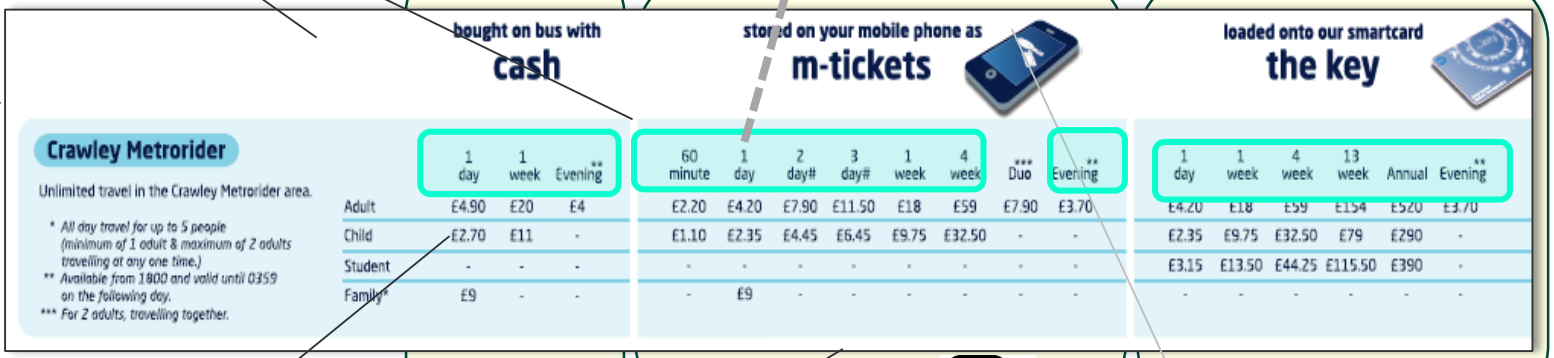
Department for Transport

Season Pass with choice of durations – TIME INTERVALS





TIME INTERVALs



FARE ZONE

FARE PRICEs

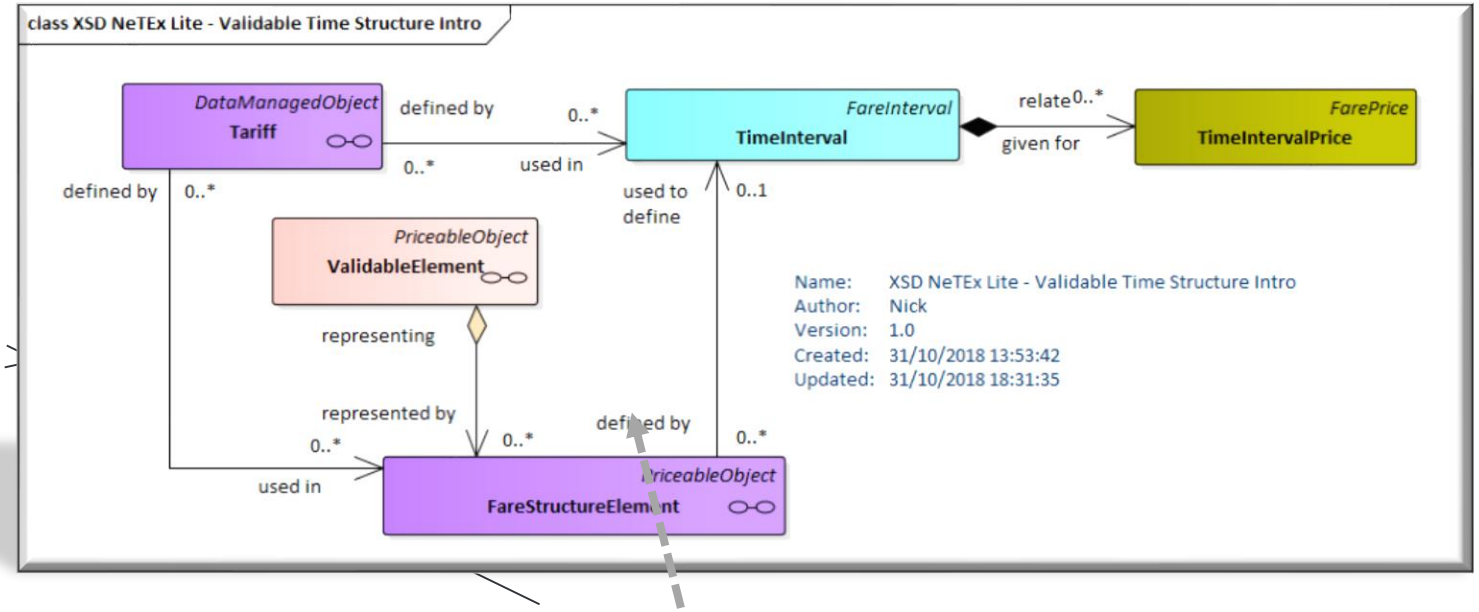
SALES PACKAGEs

TYPE OF TRAVEL DOCUMENTs

Department for Transport

Season Pass with choice of durations – TIME INTERVALS

TIME INTERVALs

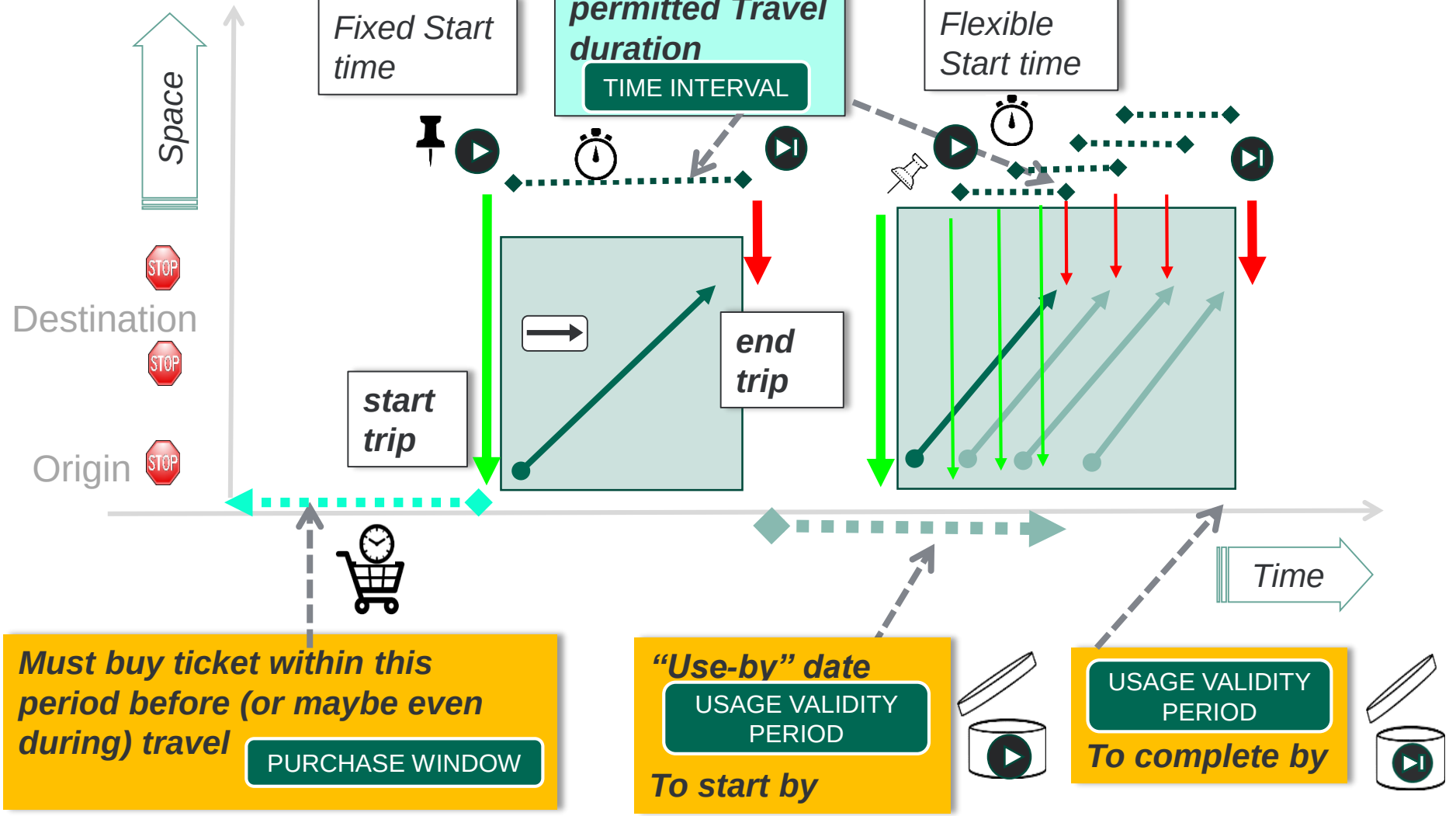


60 minute	1 day	2 day#	3 day#	1 week	4 week	... Duo
£2.20	£4.20	£7.90	£11.50	£18	£59	£7.90
£1.10	£2.35	£4.45	£6.45	£9.75	£32.50	-
.	.	.	.	.	.	.
.	£9	.	.	.	.	.

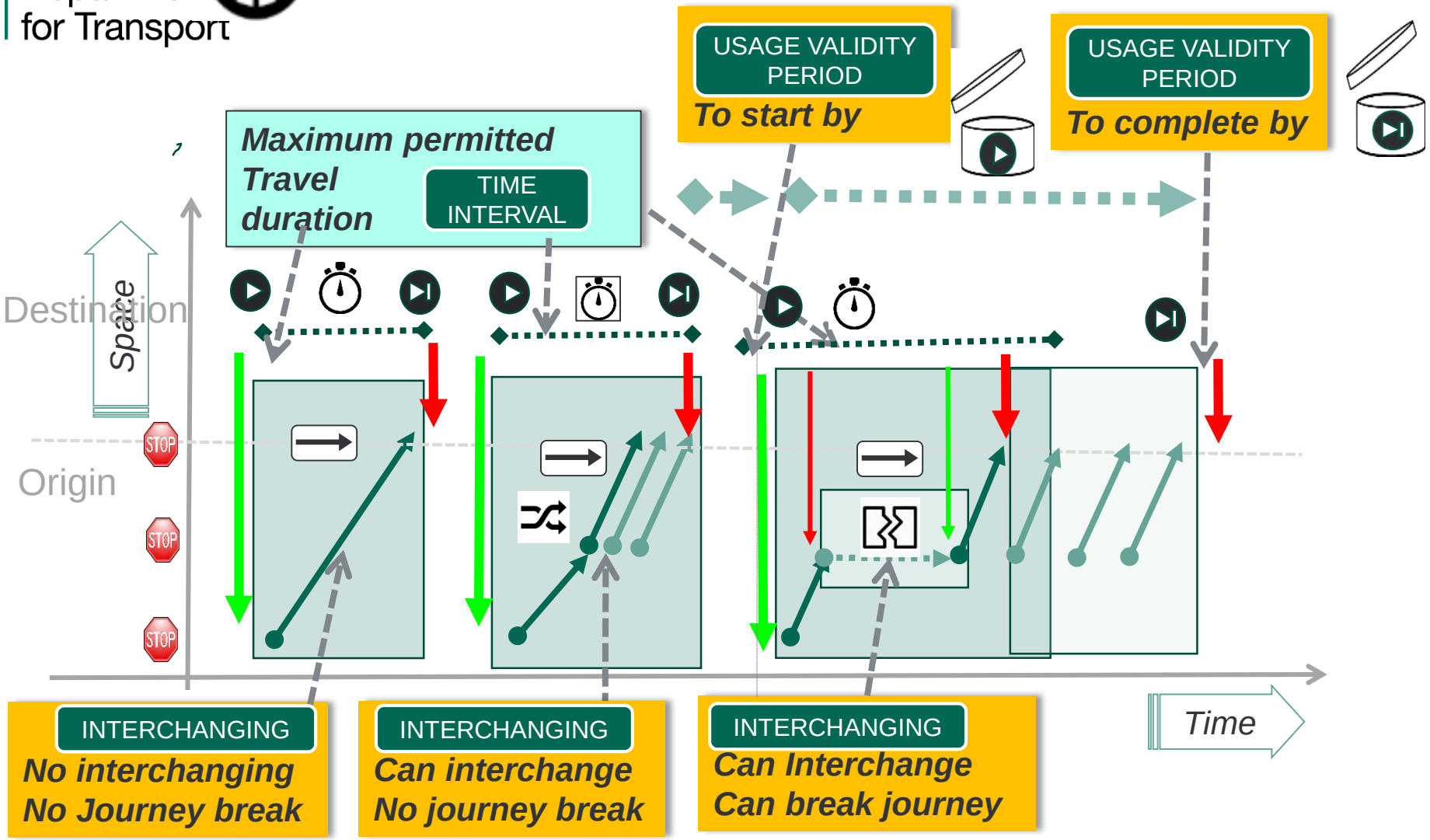
Department for Transport

2. Use-by dates (And other commercial conditions)

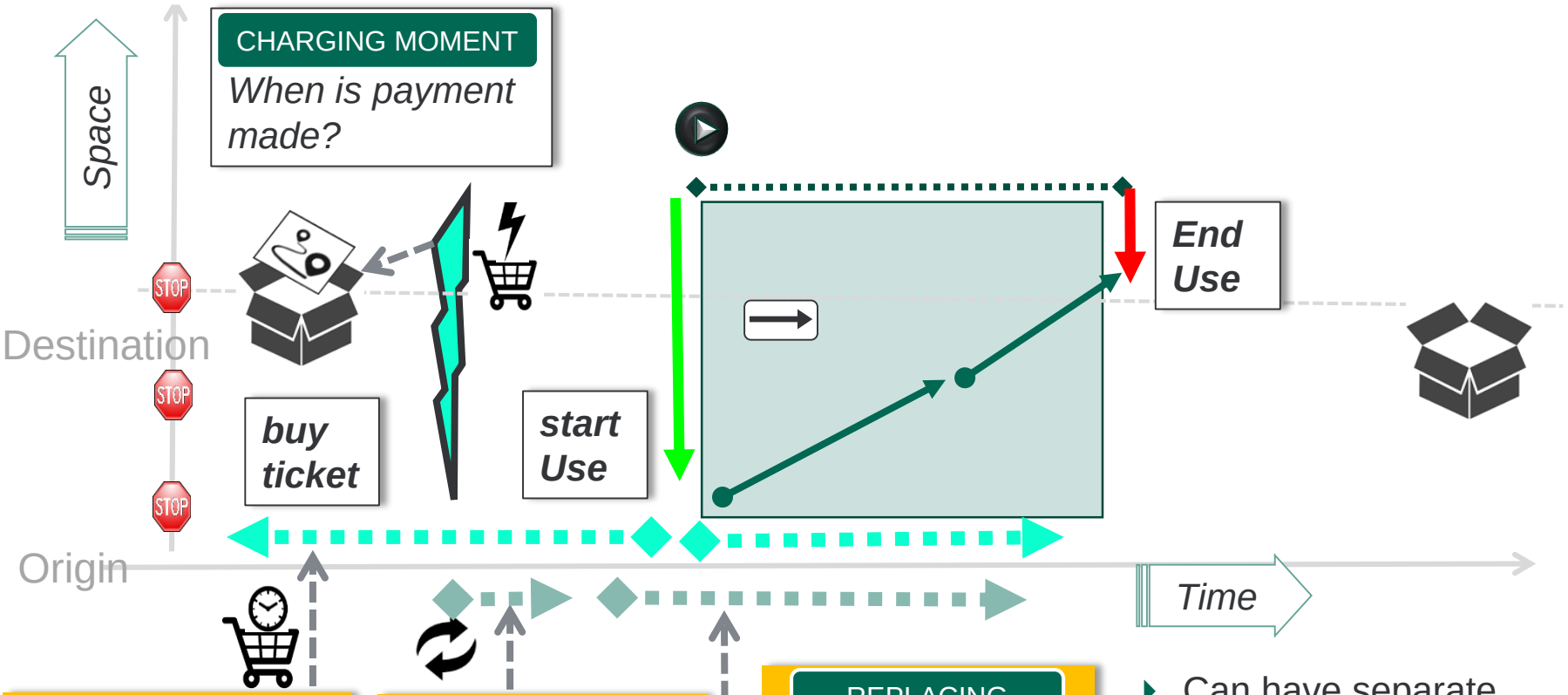
Trips – Basic time concepts



Single Trip – More TIME concepts



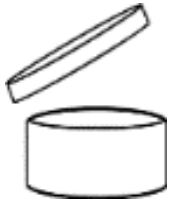
Products – Time concepts reating to commercial conditions



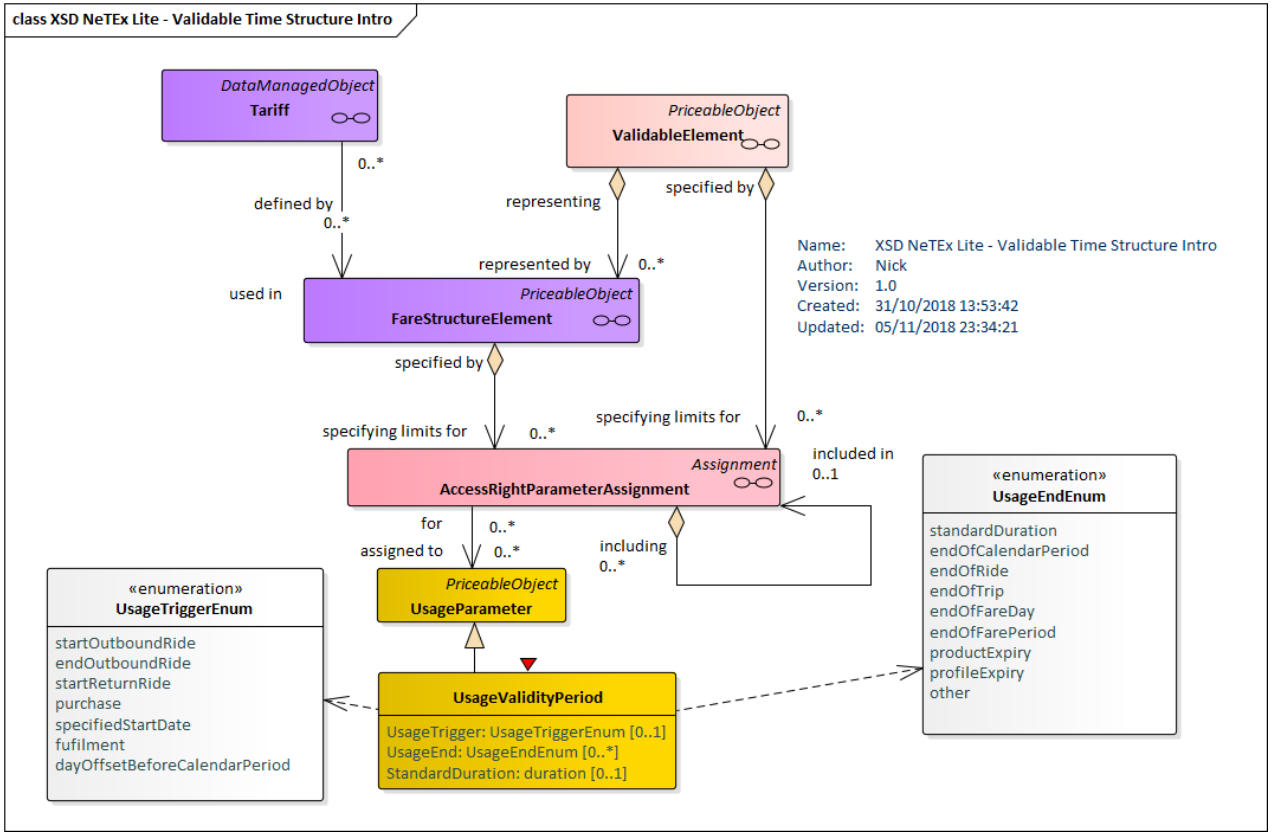
- Can have separate conditions to a FARE PRODUCT, and a whole SALE OFFER PACKAGE comprising several products

Department for Transport

Specifying a “Use by date” and othe validity periods



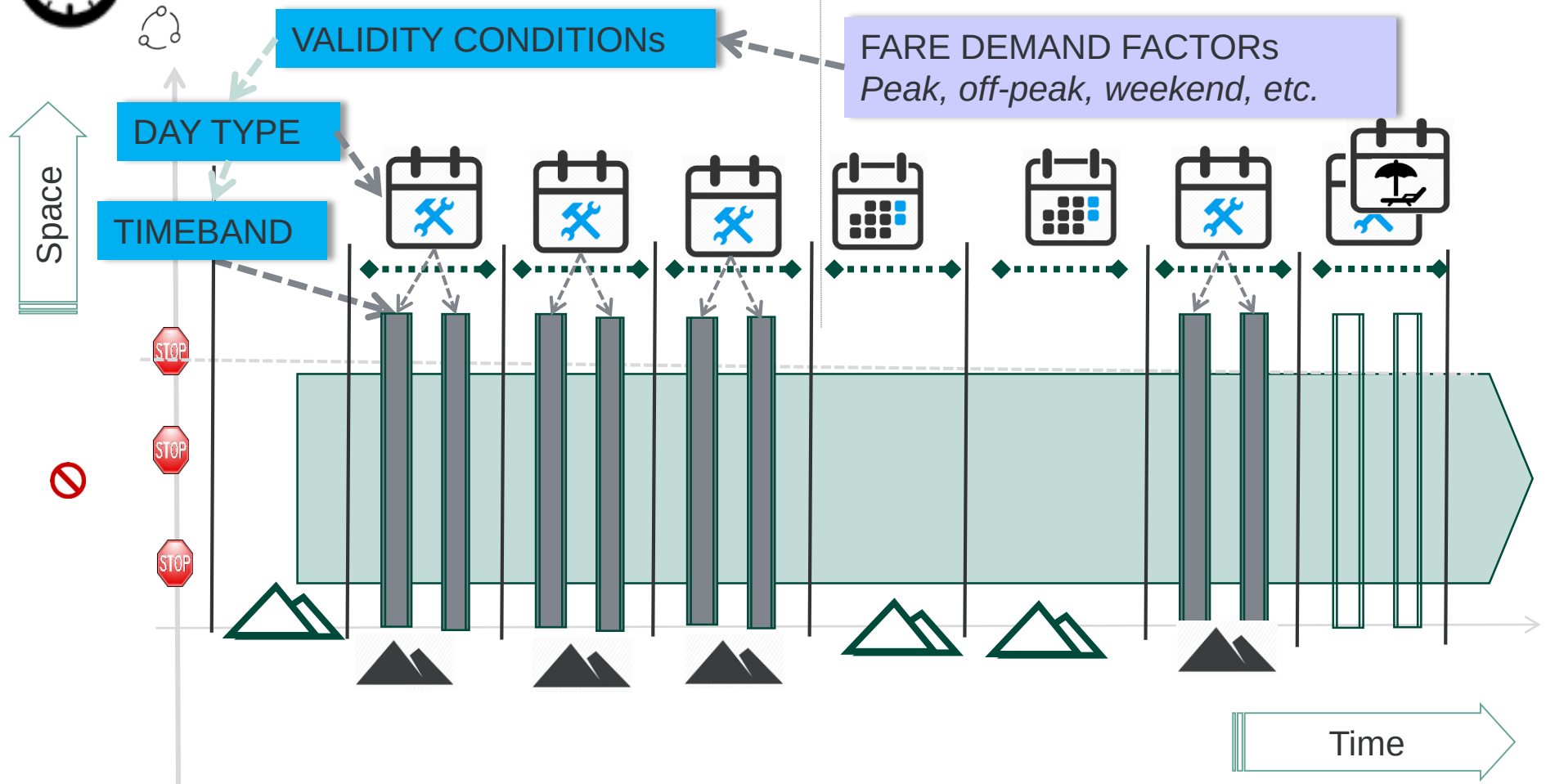
- Assiginng USAGE VALIDITY PERIOD parameter
- Can be used to set “Use by date” as interval from a given point in time,
  - Eg Purchase, fulfilment start of trip, start of outbound etc



Department for Transport

3. Peak/Offpeak Fare Demand periods

: Peak /Off-peak Fares & Blackouts



Department for Transport

Peak and Offpeak – Fares

- E.g. Concessionary Pass prduct has use restrictions

Crawley Area Metrorider
Metrovoyager
Discovery Ticket
Gatwick Travelcard

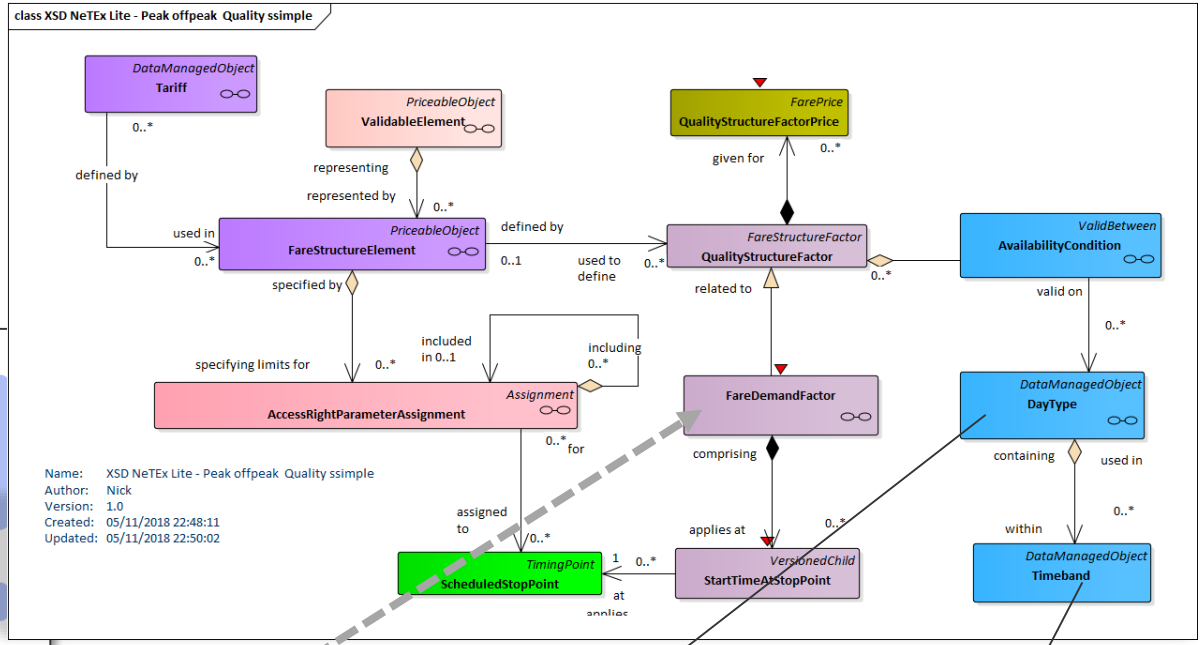
Accepted throughout.

PlusBus

Crawley, Three Bridges, Gatwick Airport, Ifield and Horley PlusBus tickets are valid throughout. Please see www.plusbus.info for further information.

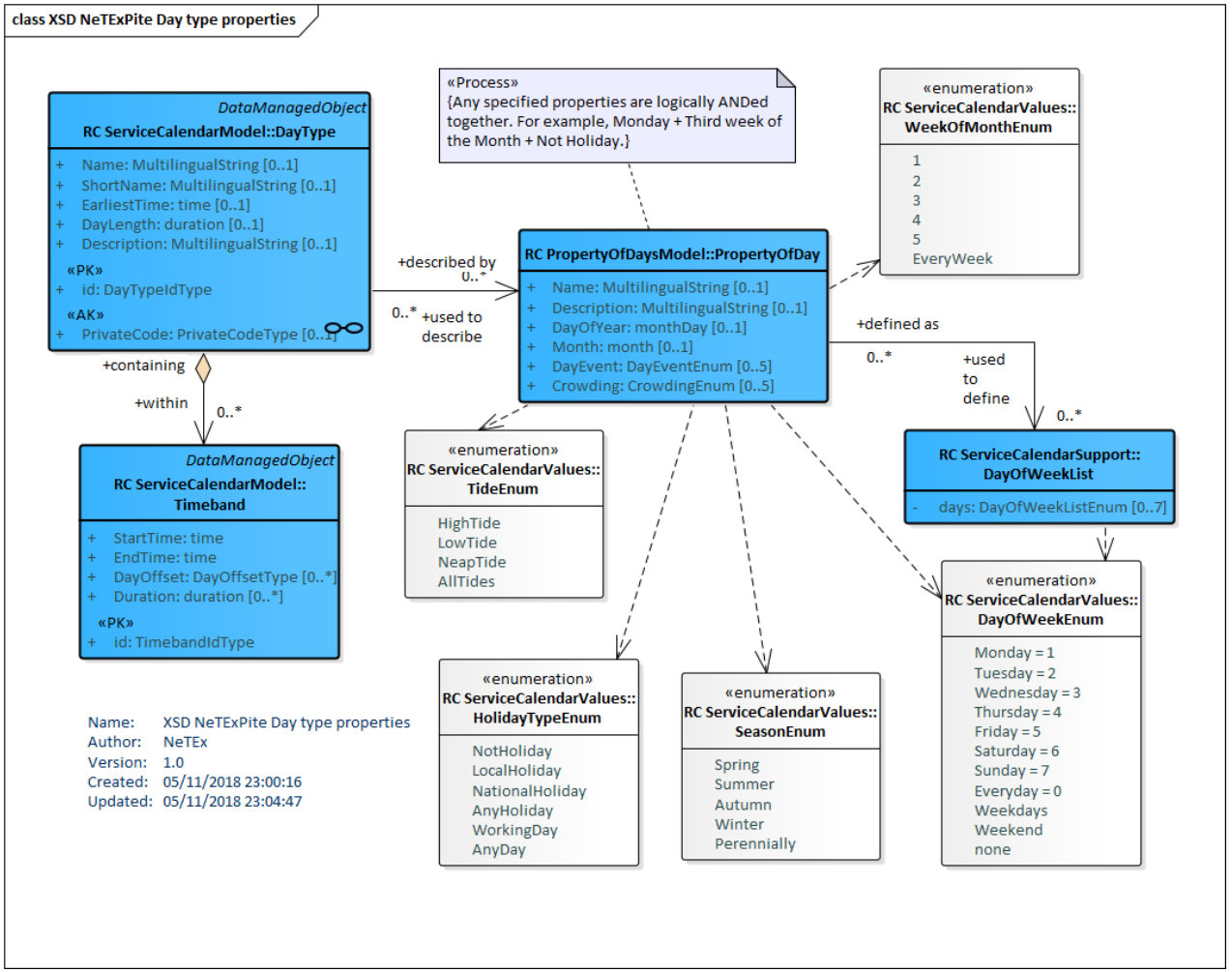
Concessionary Passes

Concessionary passes are valid throughout from 0930-2300 Mon-Fri, and anytime at weekends and public holidays.



Defining a day type

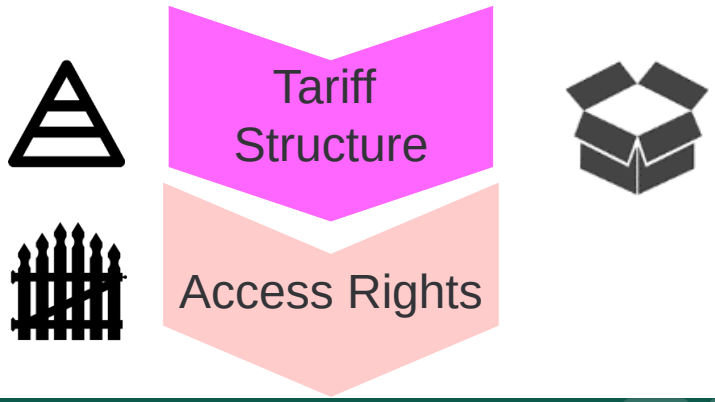
- For example
- Monday to Friday
- Saturday



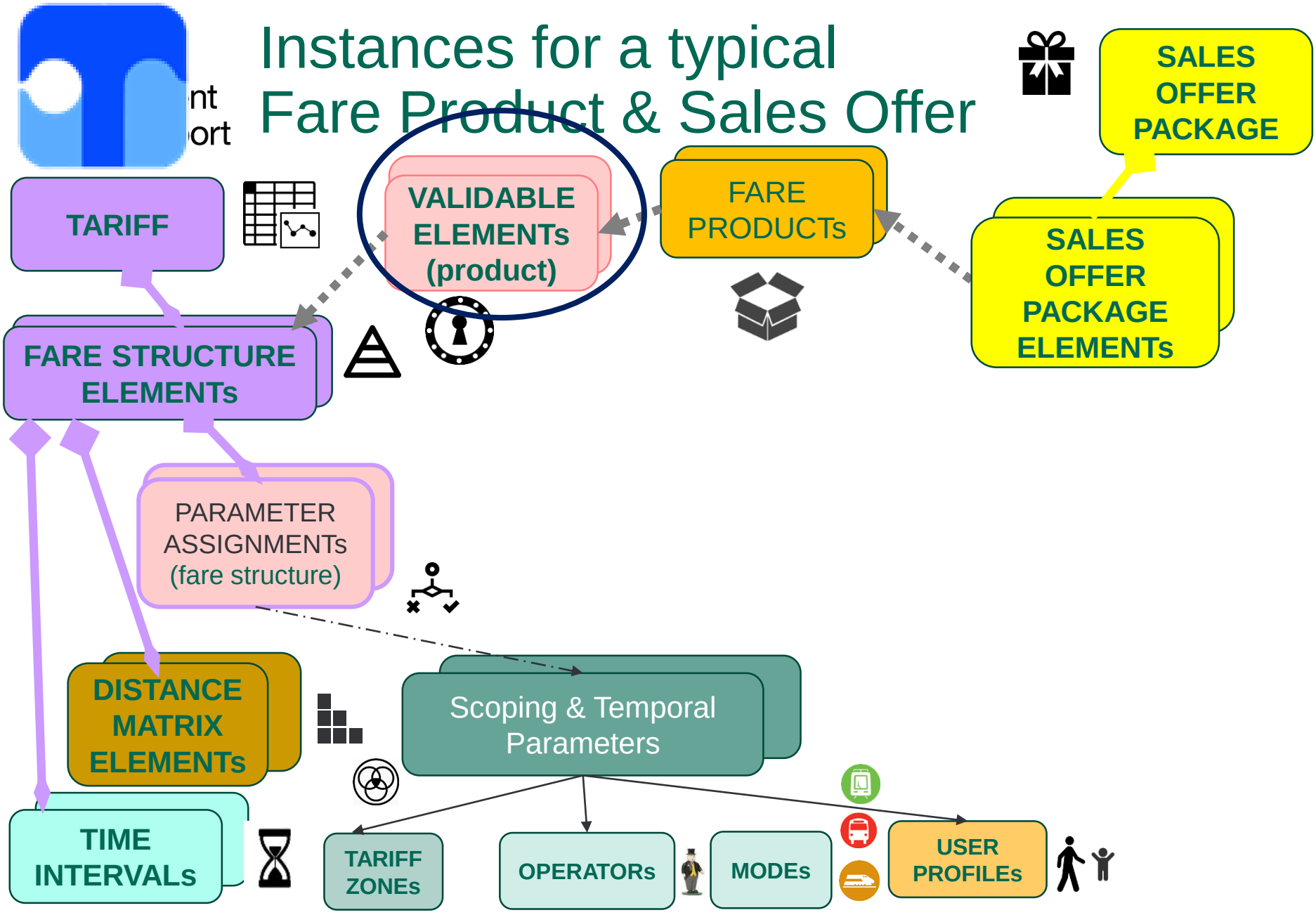
Department for Transport

UK Bus Fares NeTEx Profile

Associating access rights with Products and Sales Offers



Instances for a typical Fare Product & Sales Offer



Department for Transport

Validable Elements

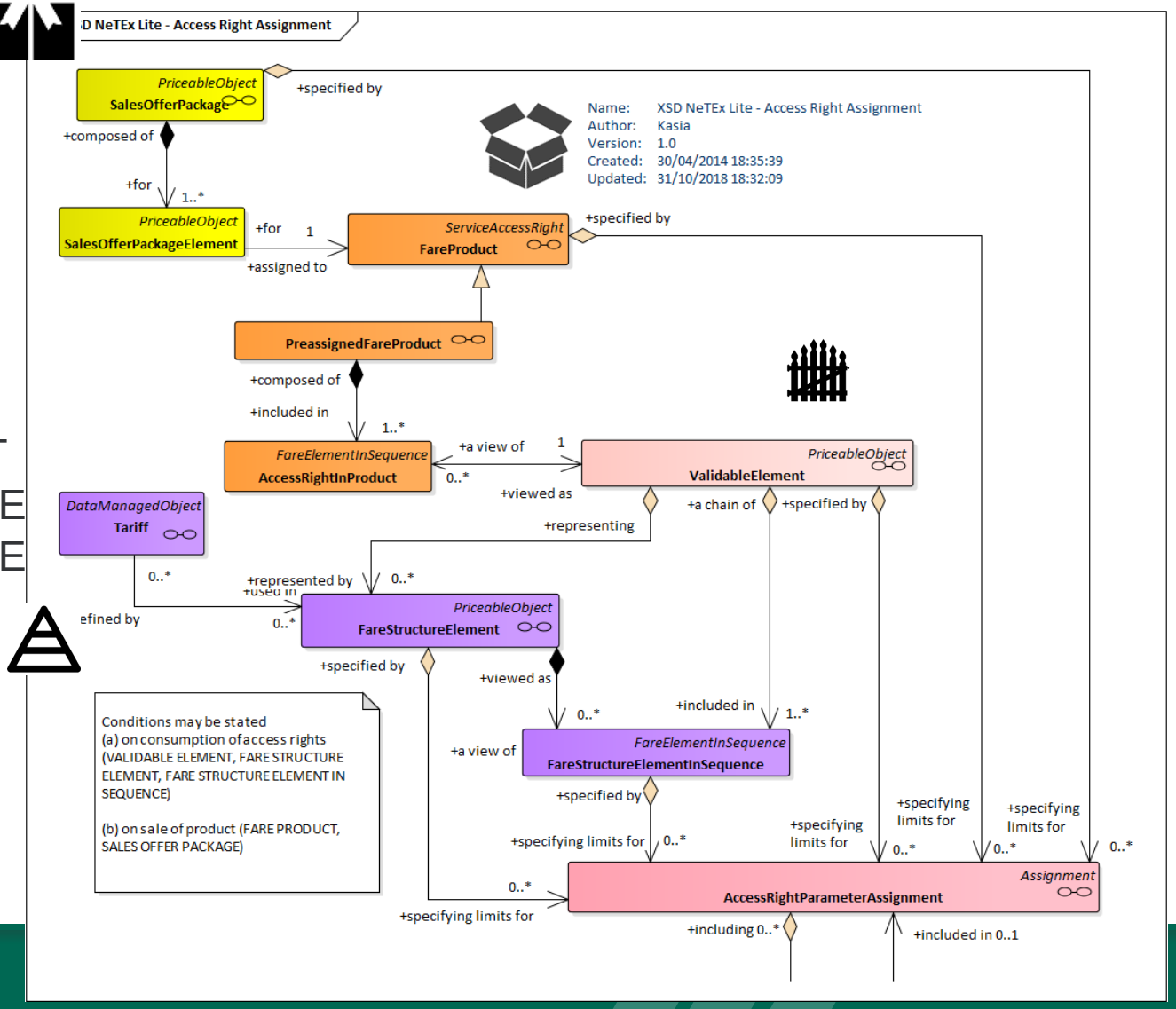
- VALIDABLE ELEMENT groups sets of access rights from the Tariff structure for use in FARE PRODUCTs
  - Can be used in more than one product
    - ACCESS RIGHTS IN PRODUCTs as VALIDABLE ELEMENTs
  - VALIDABLE ELEMENTS typically correspond to sets of parameters that can be valduated or control by the control system
    - E.g. A bus ride between a origin and destination
    - E.g. A Day pass in a specified zone
- VALIDABLE elements use Fare STRUCTURE ELEMENTs
  - These may include alternative choices
  - E.g. The set of O/Ds as DISTANCE MATRIX ELEMENTs
  - E.G. The allowed durations for Season Passes
  -

Department for Transport

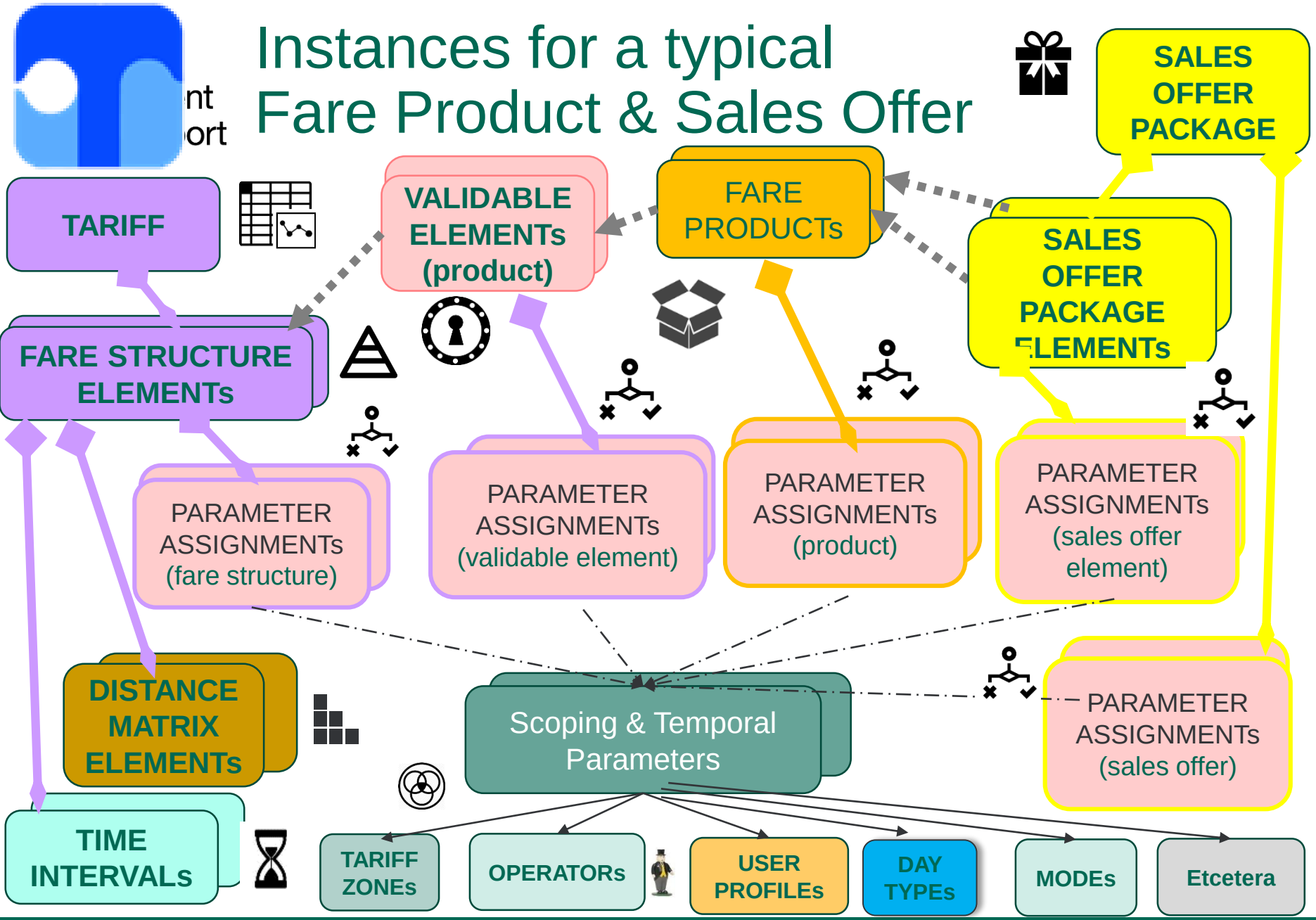
Associating access rights with a specific product – VALIDABLE ELEMENTs The General Case

Parameters can be assigned to any of

- FARE STRUCTURE ELEMENT
- VALIDABLE ELEMENT
- FARE PRODUCT
- SALES PACKAGE
- SALES PACKAGE

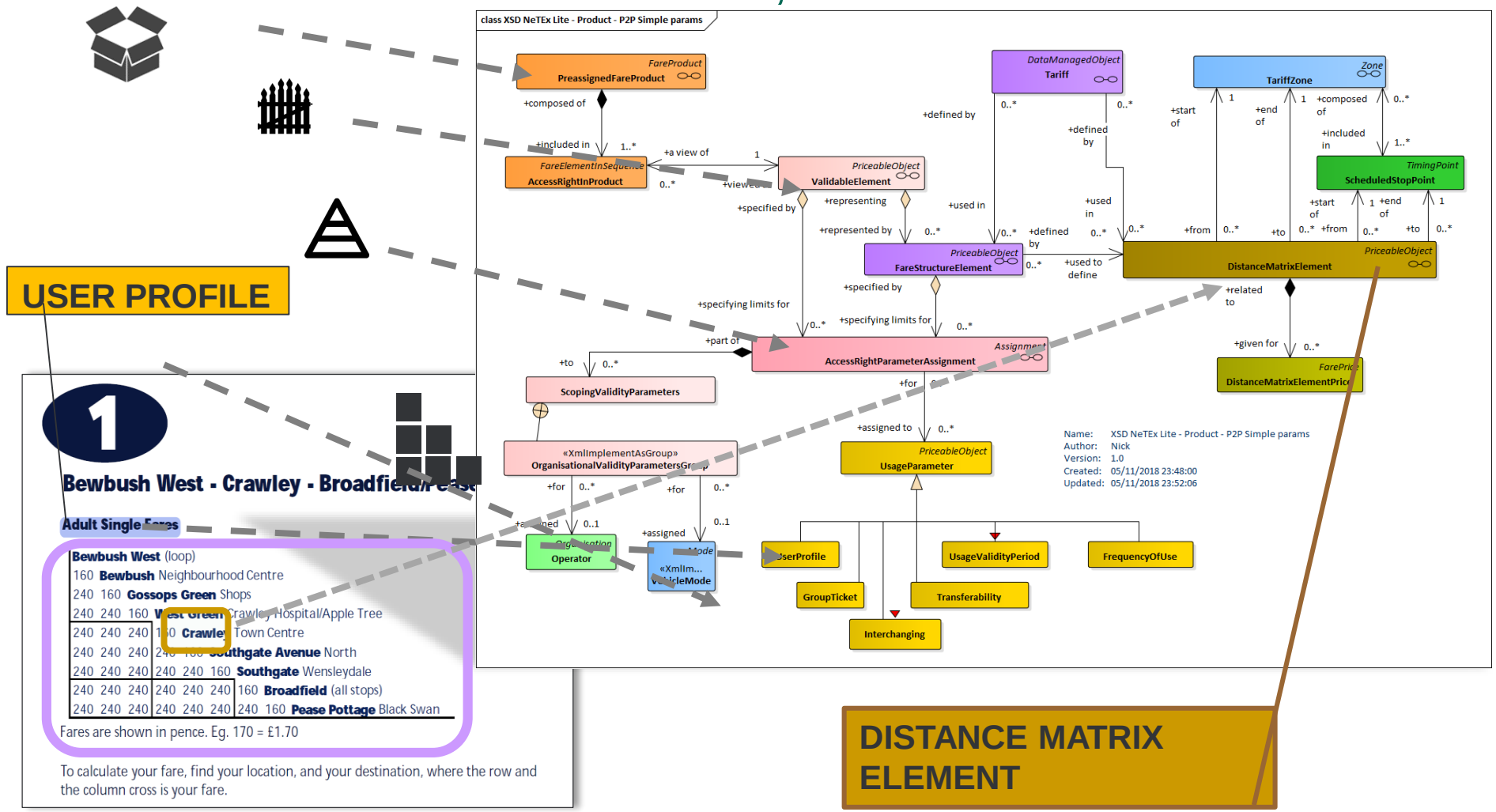


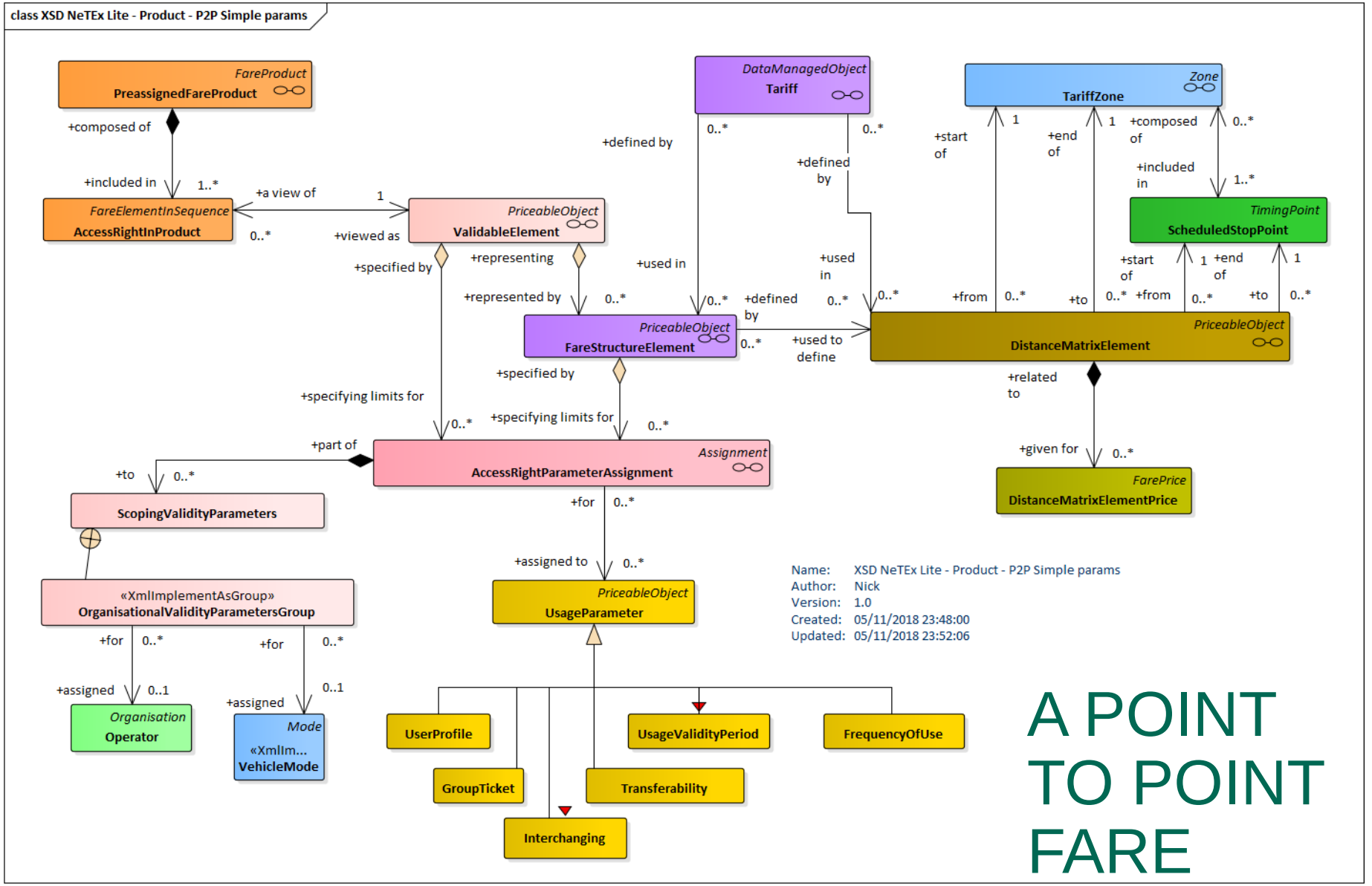
Instances for a typical Fare Product & Sales Offer



Department for Transport

A Zone to Zone Product: Use DISTANCE MATRIX + Assign OPERATOR, MODE, USER PROFLEs, etc

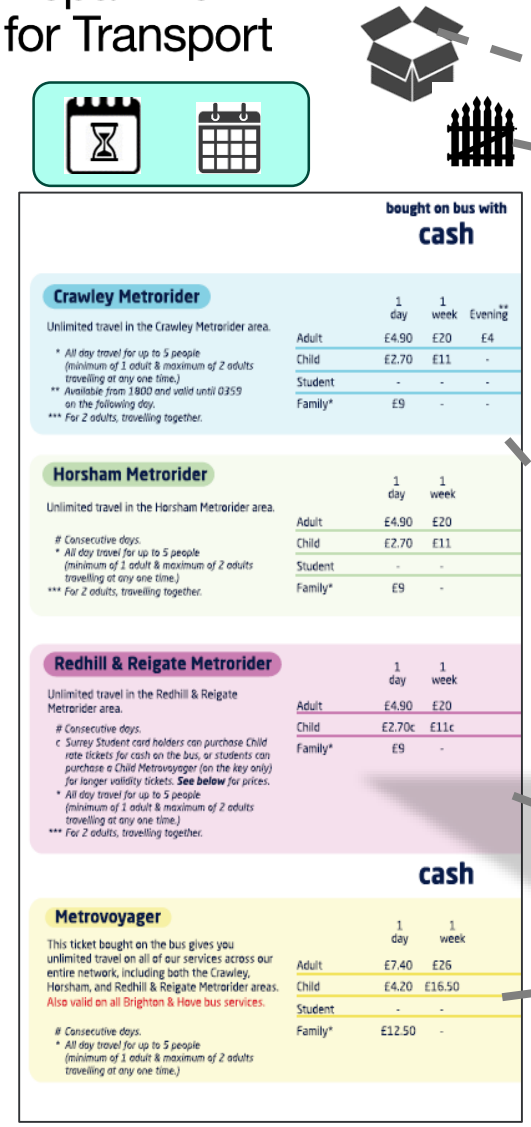


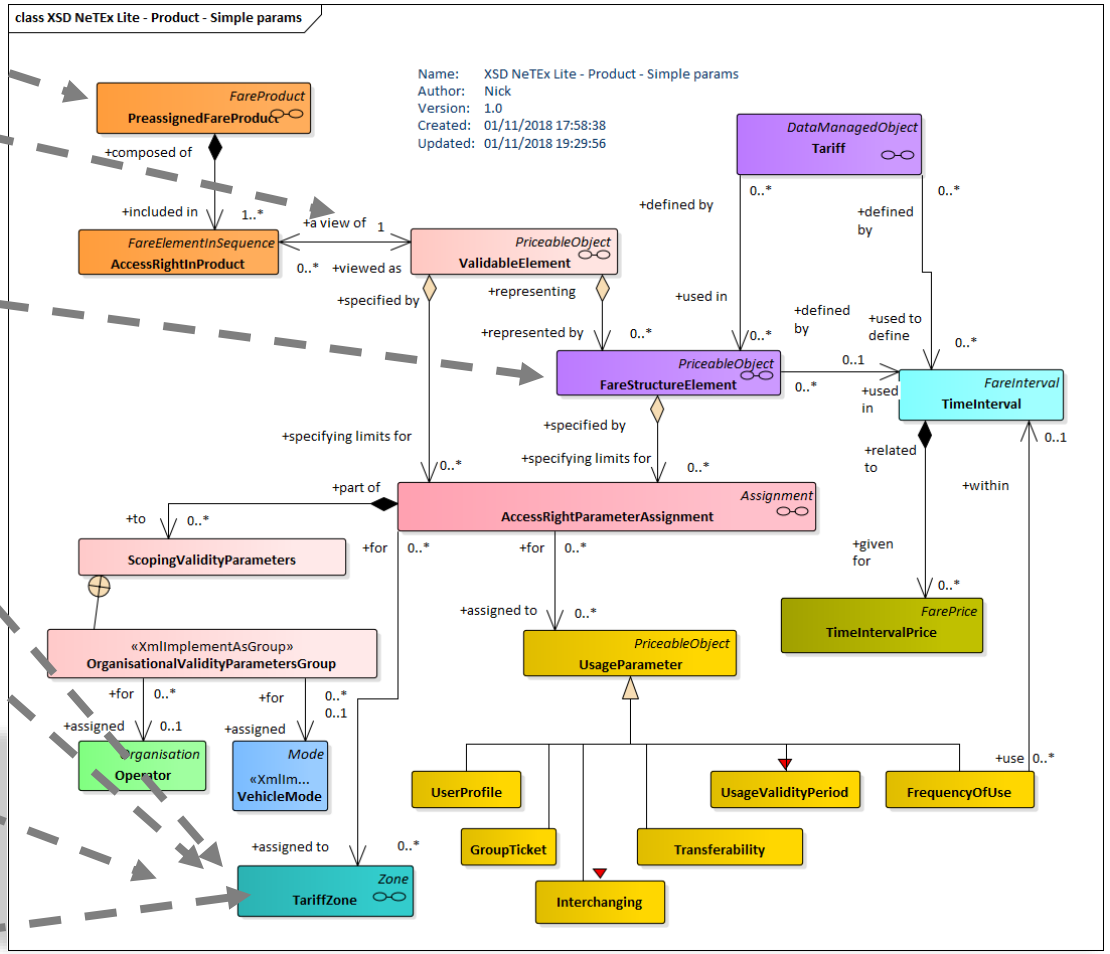


A POINT TO POINT FARE PRODUC

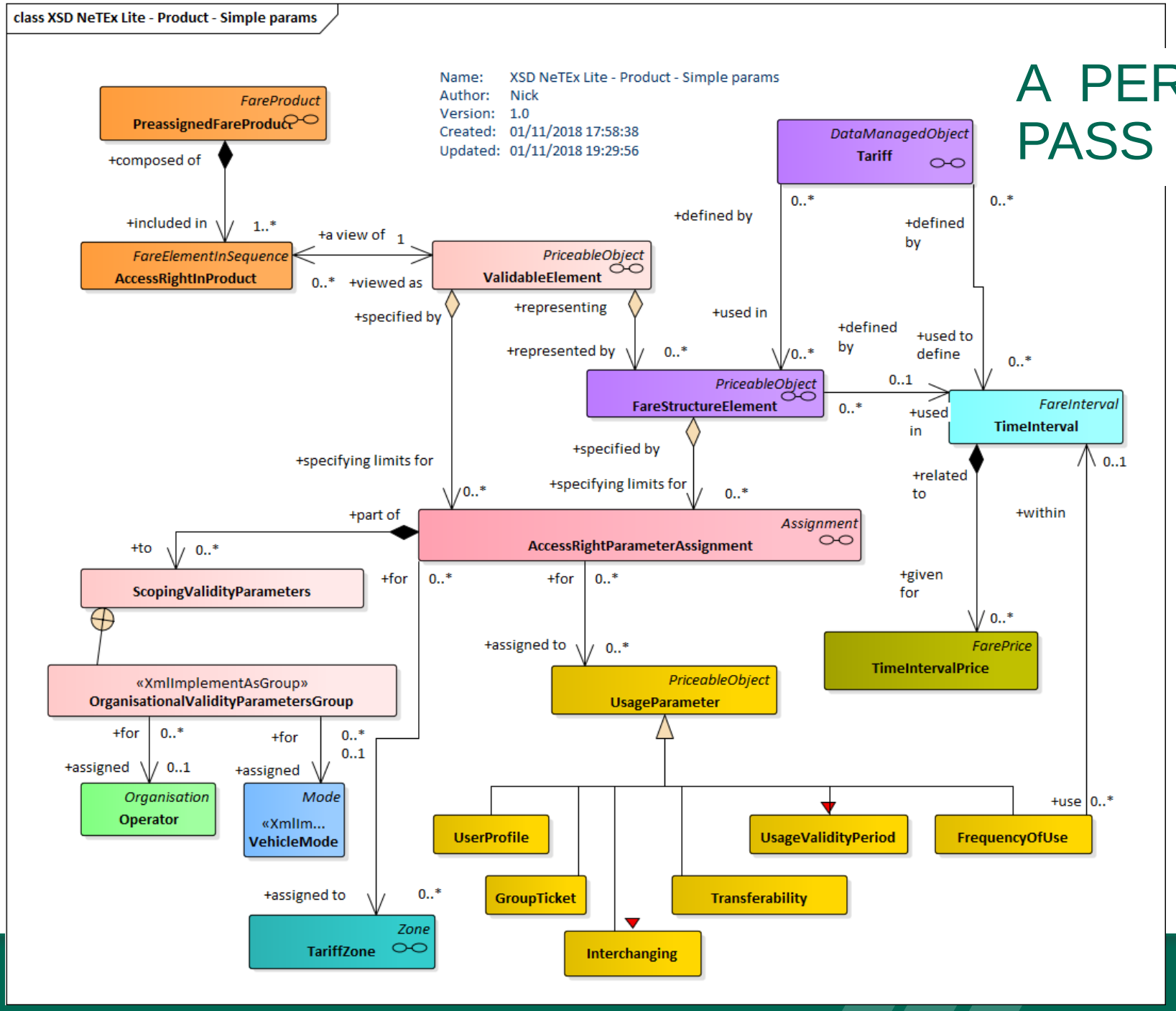
A Season Pass Product : Assign FARE ZONEs + OPERATOR, MODE, & USER PROFILEs

Department for Transport





A PERIOD PASS



Department for Transport

UK Bus Fares NeTEx Profile

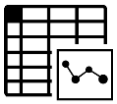
What product options and features need to be included / excluded?

- User Profiles
- Group Tickets
- Travel Conditions
- Luggage
- Sales and after sales
- Pduct Entitlements

Instances for a typical Fare Product & Sales Offer

SALES OFFER PACKAGE

TARIFF



VALIDABLE ELEMENTs (product)

FARE PRODUCTs

SALES OFFER PACKAGE ELEMENTs

FARE STRUCTURE ELEMENTs

PARAMETER ASSIGNMENTs (product)

DISTANCE MATRIX ELEMENTs

Scoping & Temporal Parameters

TIME INTERVALs

TARIFF ZONEs

OPERATORs

USER PROFILEs

DAY TYPEs

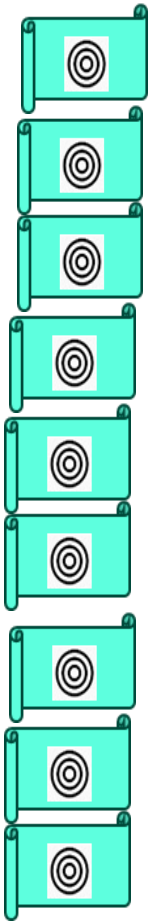
MODEs

Etcetera

Department for Transport

#6.1: UK Bus Fares - User Types?

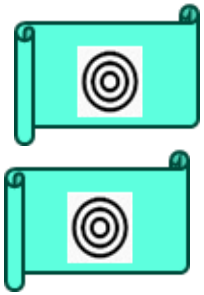
USER PROFILE	Personal	Discounted	Note
Adult	x	x	Over 16
Infant	x	✓	Babes in arms free
Child	x	✓	c5 – c16 years
Youth	x	✓	c16-18 years
School Pupil	x	✓	At School
Student / Trainee	✓	✓	University, APprentice
Senior	✓	✓	Resident, >60 years
Disabled	✓	✓	Registered disabled
Disabled Companion	✓	✓	With disabled
Job seeker	✓	✓	



Department for Transport

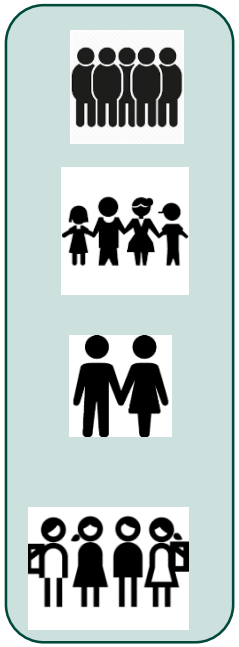
#6.2: UK Bus Fares – Corporate User Types?

CORPORATE PROFILE	Personal	Discounted	Note
Armed Forces	✓	✓	Registered
Employee Scheme	✓	✓	E.g. Gatwick Airport Staff

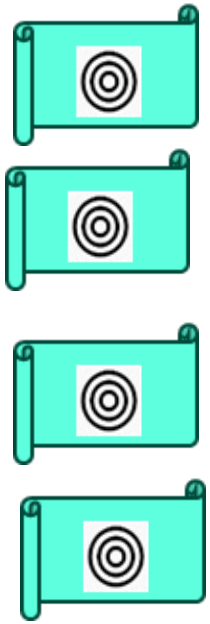


Department for Transport

#6.3: UK Bus Profile – Group Ticket Types?



GROUP TICKET	Note
Anyone	2-N Anyone
Family	1-2 Adults + 1-N, Children
Couple / Duo	2 Adults
School Pupils	1-N Adults + 2-N Pupils



Department for Transport

UK BUS Product parameters – Travel Conditions

		Relevance				
Condition	**Condition**	**Local Trip**	**Coach Trip**	**Season Ticket**	**Note**	USAGE PARAMETER
TRAVEL HOW	**Right to Interchange**	✓	✓	X	Trips only	INTERCHANGING
	Right to Break Journey	✓	✓	X	Trips only	INTERCHANGING
	Routing Restrictions	X	?	X		ROUTING
	Round Trip	✓	✓	X	Single, Period Return, Day Trip	ROUND TRIP
TRAVEL WHEN	**Usage Validity Period**	✓	✓	✓	See discussion of temporal factors	USAGE VALIDITY PERIOD
	Frequency of Use	X	X	✓	e.g. 2 per day, vs unlimited use	FREQUENCY
	Minimum Stay	x	?	x	Excursion products only?	MINIMUM STAY

Department for Transport

UK BUS Product parameters – Luggage allowances

- For bus, Passenger information only? No pricing implications

Condition	LUGgAGE ALLOWANCE	Relevance: Local Trip	Relevance: Coach Trip	Relevance: Season Ticket	Note
Suitc	Pram	✓	✓	X	Trips only
	Wheelchair	✓	✓	X	Trips only
Suitcase	Suitcase	✓	✓	X	Trips only. Might be cahrgable for coach
Animal	Guide dog	✓	✓	✓	See discussion of temporal factors
	Pet	X	X	✓	e.g. 2 per day, vs unlimited use

Department for Transport

UK BUS Product Parameters – Sales & After-Sales Conditions

		Relevance			
Condition	Condition	Local Trip	Coach Trip	Season Ticket	USAGE PARAMETERs
Presales	Period in which a ticket can be bought.	?	✓	✓	PURCHASE WINDOW
	Period and conditions for reserving a ticket.	x	✓	x	RESERVING
	Can ticket be given to another to use?	✓	✓	✓	TRANSFERABILITY
After Sales	Can reservation be cancelled?	x	✓	x	CANCELLING
	Can you modify travel times or change journey details?	x	✓	x	EXCHANGING
	Can you get all or some money back?	?	✓	✓	REFUNDING
	Can you get a replacement for a lost ticket?	x	✓	✓	REPLACING

Department for Transport

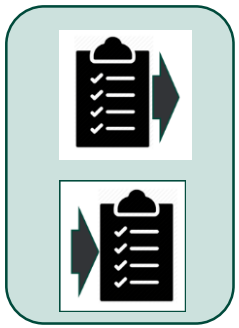
UK BUS Product parameters – Luggage allowances

- For bus, Passenger information only? No pricing implications

		Relevance			
Condition	LUGGAGE ALLOWANCE	**Local Trip**	**Coach Trip**	**Season Ticket**	**Note**
Suitc	**Pram**	✓	✓	X	Trips only
	Wheelchair	✓	✓	X	Trips only
Suitcase	**Suitcase**	✓	✓	X	Trips only. Might be cahrgable for coach
Animal	**Guide dog**	✓	✓	✓	See discussion of temporal factors
	Pet	X	X	✓	e.g. 2 per day, vs unlimited use

Prerequisites & Dependencies between products

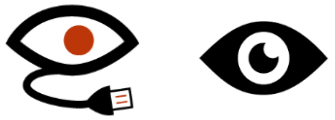
- How may products and sales offers depend on each other



Condition☑	Note
Entitlement Required	Specifies a prerequisite product
Entitlement Given	Specifies rights to another products

Department for Transport

Commercial Conditions



What needs to be Machine readable,
What needs to be Human Readable?

- **Travel Use Conditions**
- **Commercial Conditions**
- **Sales & After Sales Conditions**
- **Commercial Information**
  - Branding,
  - Contact Details for Customer Support

Department for Transport

Representing product options and features in NeTEx

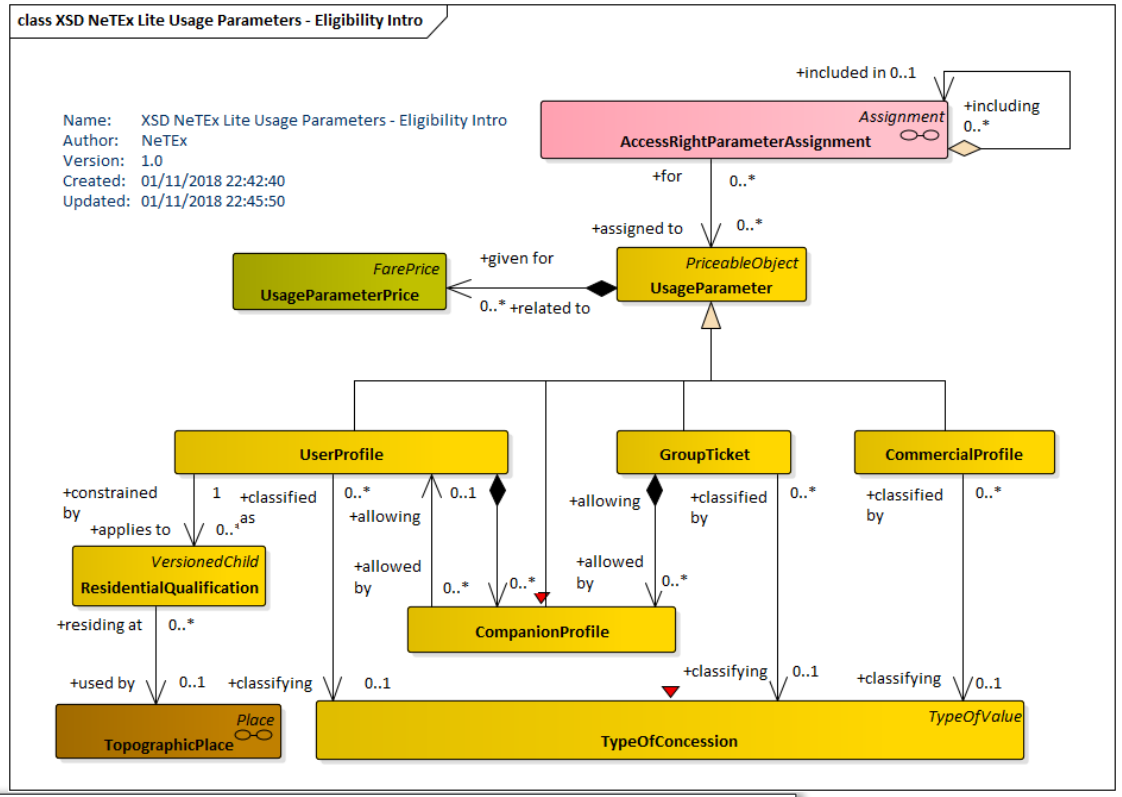
- User Types
- Group Tickets

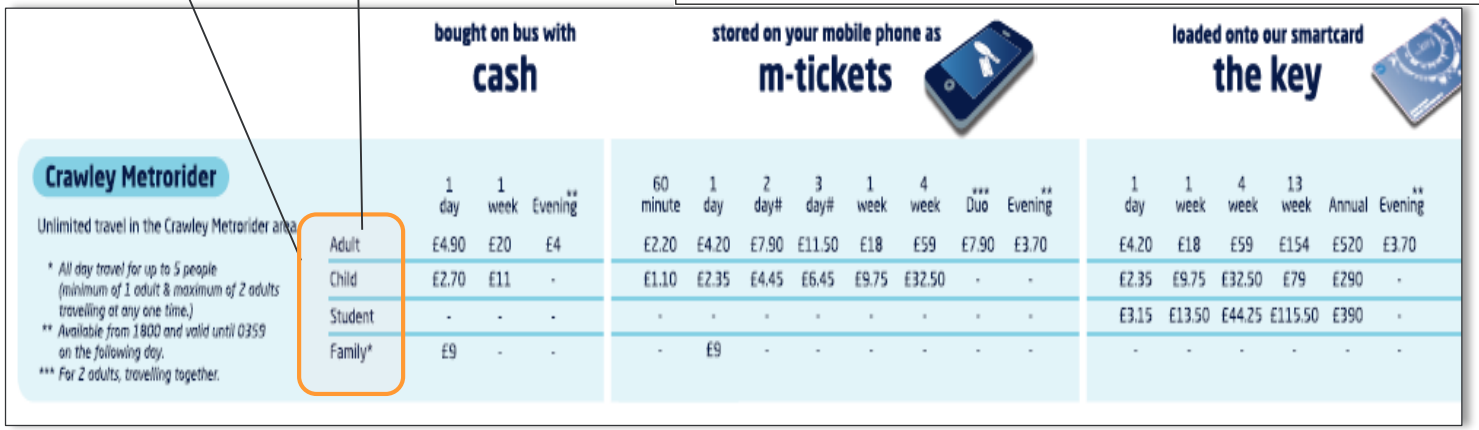
Department for Transport

User types

USER PROFILEs
Adult, Child, Student

GROUP TICKET
(Family)

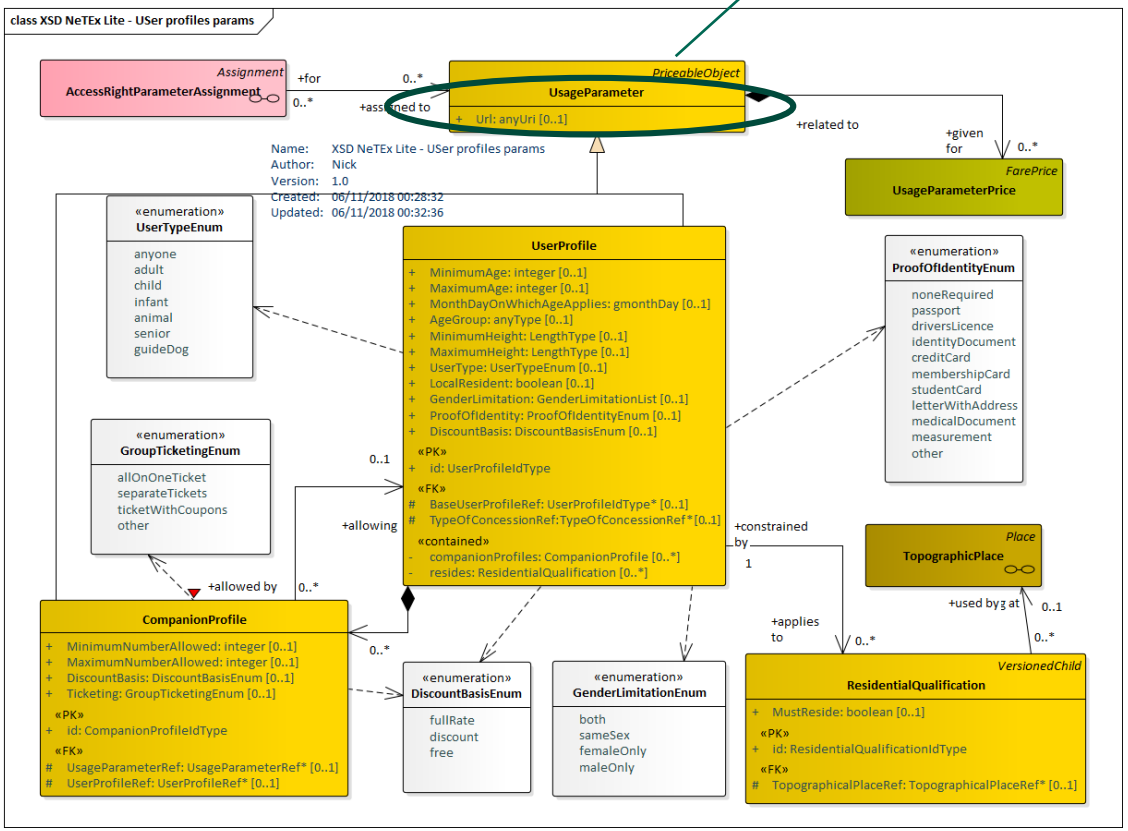




Department for Transport

User types in NeTEx: implemented as USER PROFILEs

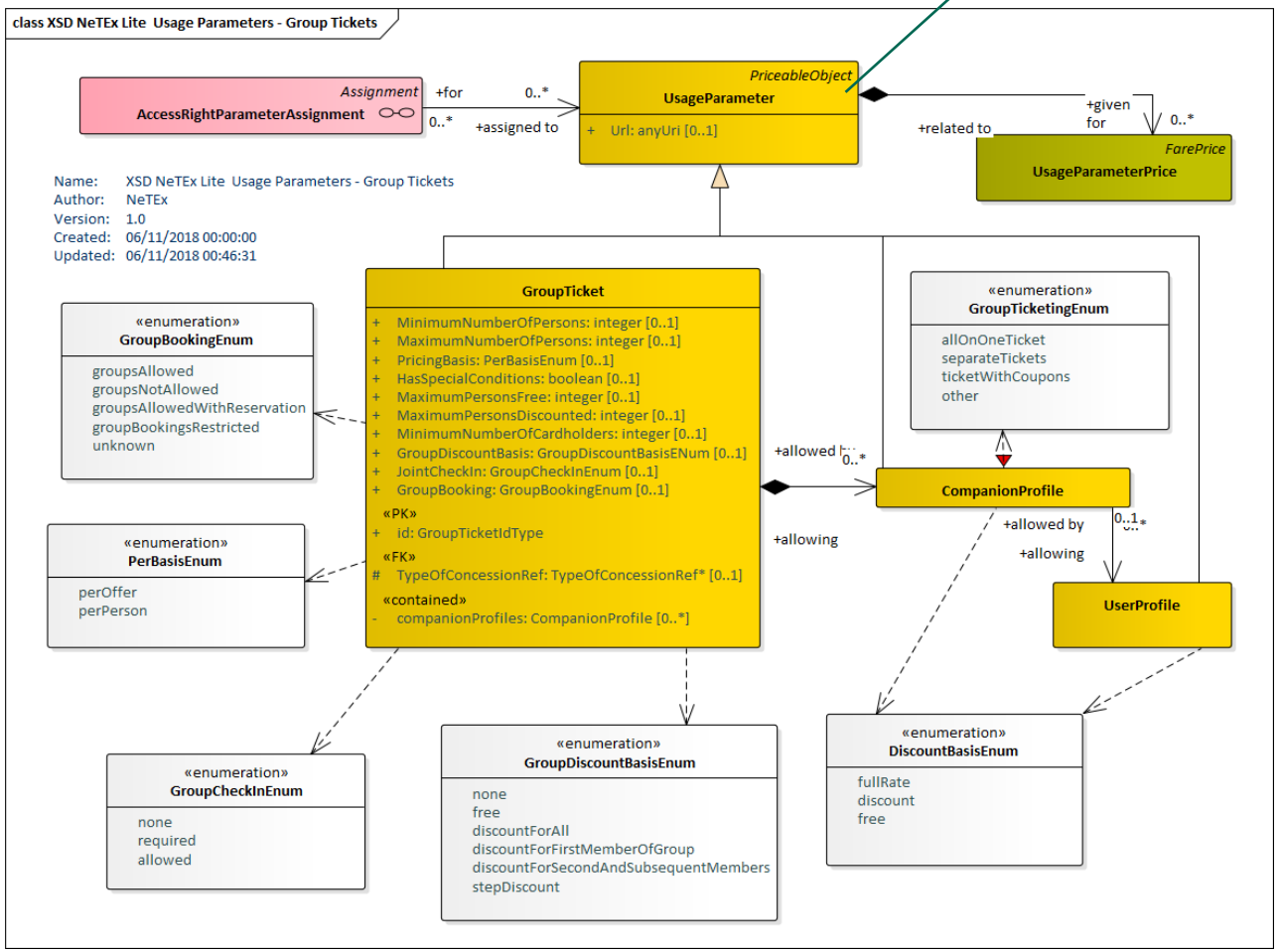
- USER PROFILE: a named user type.
- Allows for precise characterisation:
  - Minimum maximum age, et
  - Textual description
- Specialisation of USAGE PARAMETER
  - Can have url to external Web page with further description



Department for Transport

in NeTEx Implemented as GROUP TICKETs

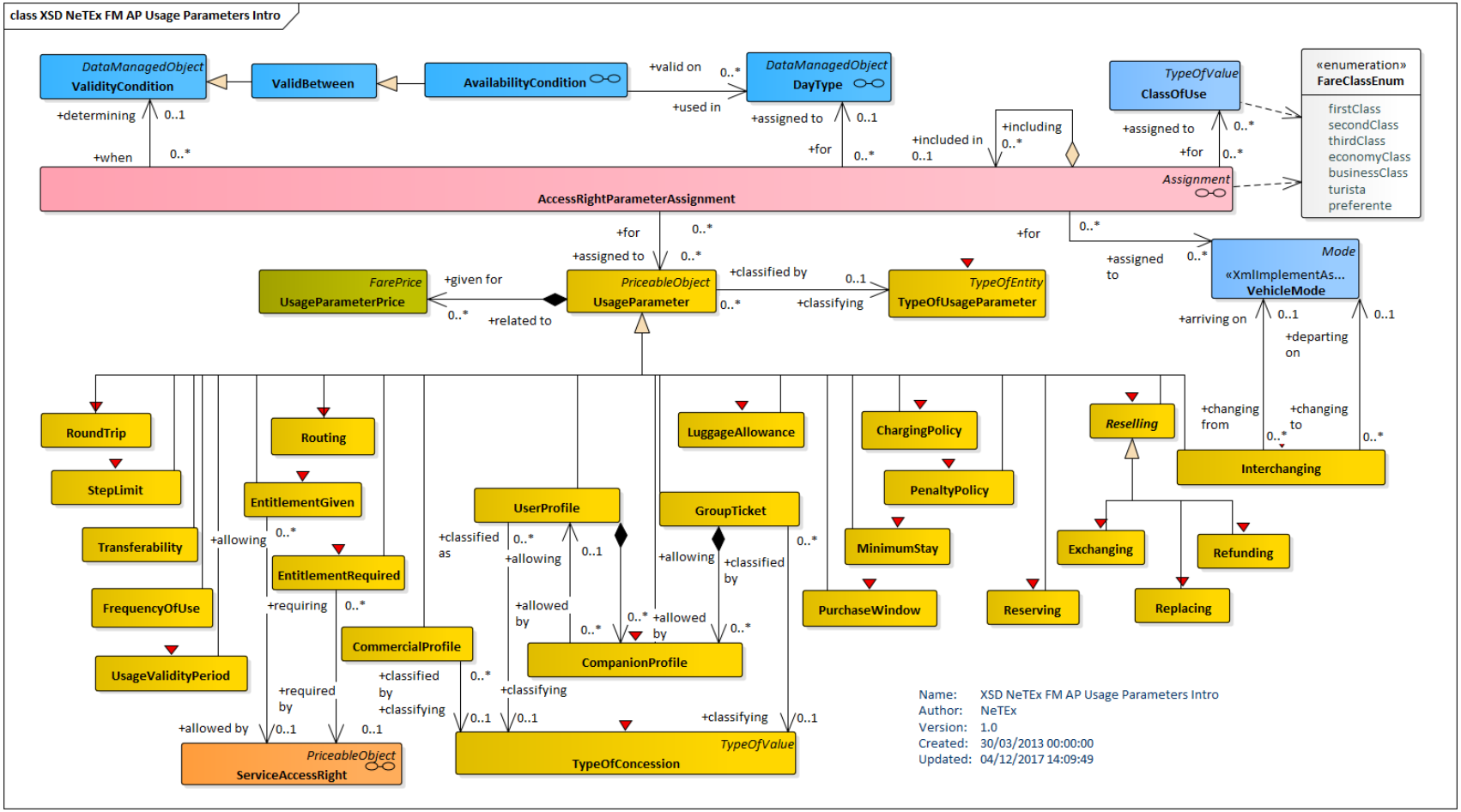
- GROUP TICKET specifies parameters for a Group
  - How many;
  - Which types of Users
  - Discount basis
  - etc
- Specialisation of USAGE PARAMETER
  - Can have url to external Web page with further description



Department for Transport

USAGE PARAMETERs - Summary

- Easy to extend with new attributes or parameters



Department for Transport

UK Bus Fares NeTEx Profile

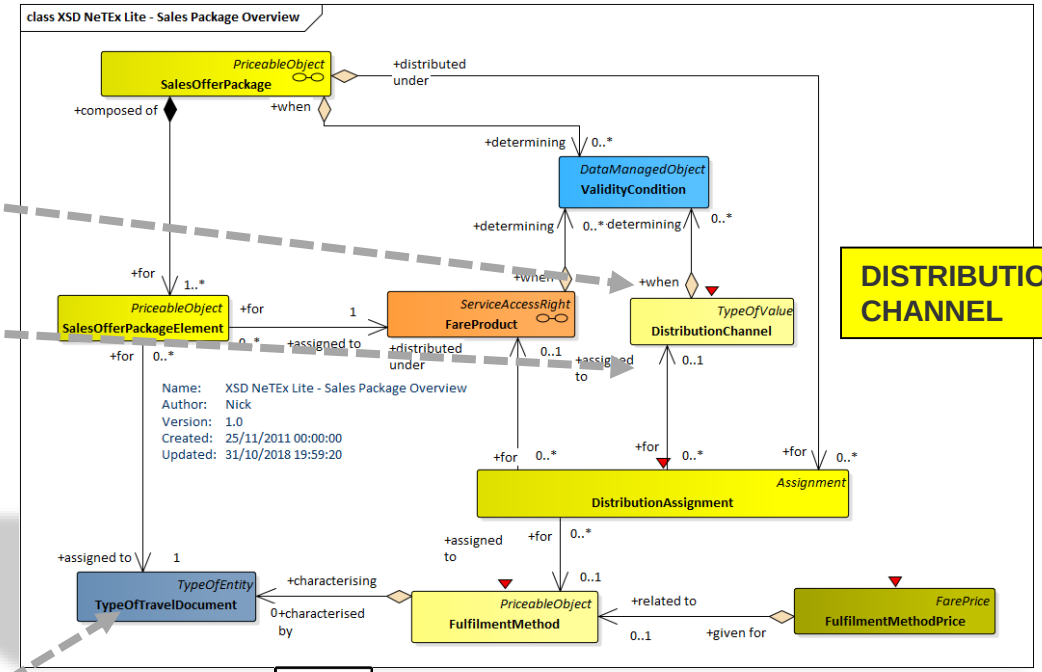
What Sales Offer and distribution features need to be included / excluded?

- Types of Travel Documents
- Distribution Channels
- Payment Methods

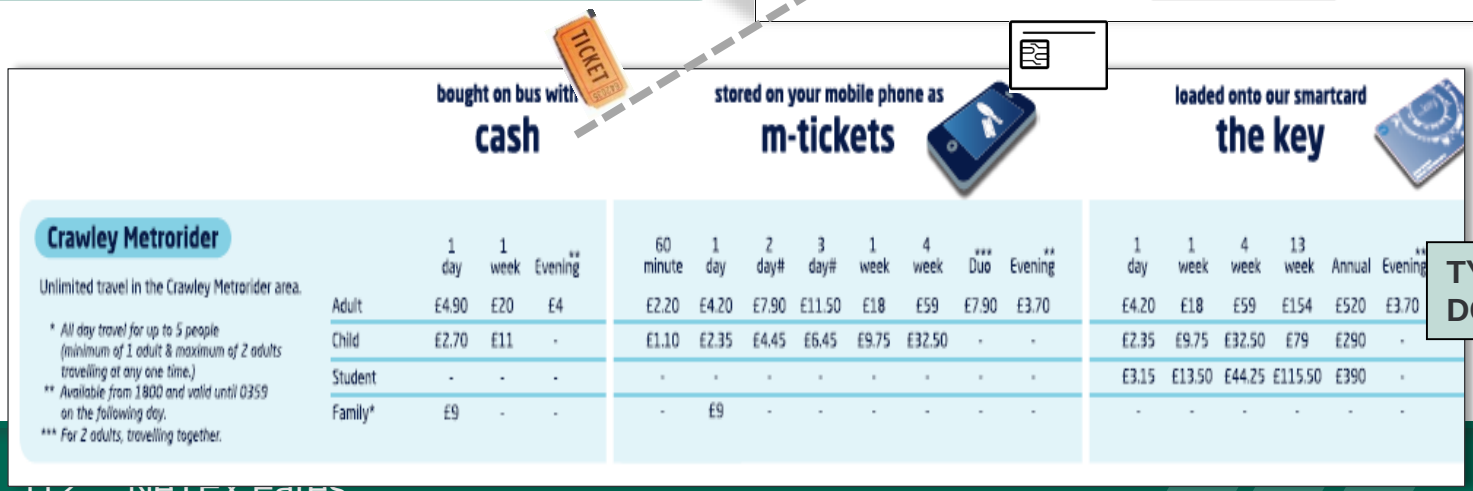
Department for Transport

Adding Distribution Parameters

PAYMENT METHOD

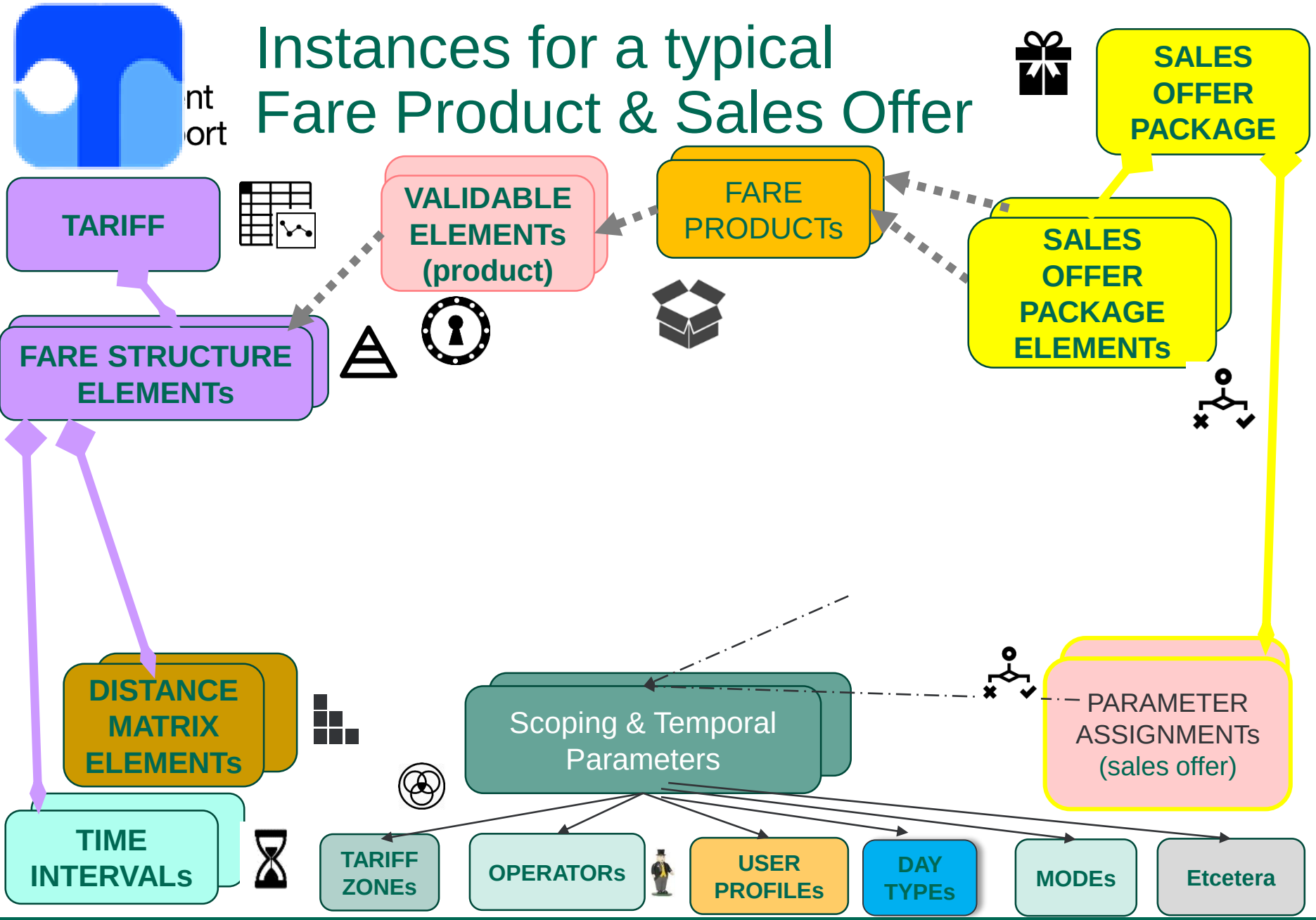


DISTRIBUTION CHANNEL



TYPE OF TRAVEL DOCUMENT

Instances for a typical Fare Product & Sales Offer

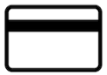


Department for Transport

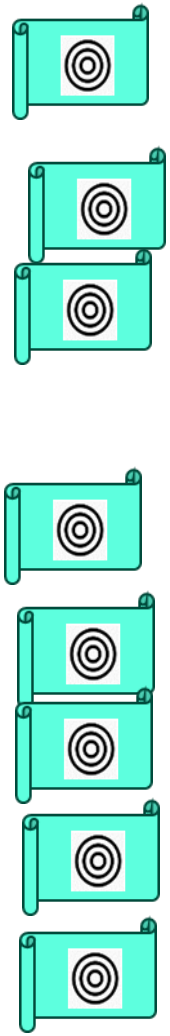
#7.1: UK Bus – Media / Travel Documents?







	TYPE OF TRAVEL DOCUMENT	Machine Readable	Human Readable	Note
VISUAL	**Paper**	Barcode, OCR, ShotCode, etc	✓	From machine or conductor
	E-document/pdf	Barcode, OCR, ShotCode, etc	✓	Self print / store on mobile device
	SMS /MMS	Barcode, OCR, ShotCode, etc	✓	
	Card	OCR	✓	e.g. Travel card
E-PASSIVE	**Magstripe**	Contact	✓	Ticket Machine / Counter only
	EMV	Contact, NFC	X	Account Based Ticketing has id but no app
E-ACTIVE	**SmartCard**	Contact, NFC	X	(ABT) Has travel app chip
	Mobile App	NFC, (bluetooth)	✓	ABT Downloadable to smart device



Department for Transport

#7.2: UK Bus – Distribution Channels?

	DISTRIBUTION CHANNEL	Fulfilment	Payment	Charging Moment	Note
Staffed	**Ticket Office Counter**	Immediate (or despatch)	Cash, Card, ePay	Prepaid	All
	On board / Conductor	Immediate	**Cash**, Card, ePay	Prepaid	Trips, day passes
	Retailer	Despatch	Card, ePay, (bank)	Prepaid	
	Call Centre	Despatch	Card, ePay, (bank)	Prepaid	Travel cards, season passes
Self Service	**Ticket Machine**	Immediate	**Cash**, Card, (ePay)	Prepaid	At Stop Also On board
	Online, mobile	Immediate or despatch	Card, ePay	Prepaid	Anywhere
	Electronic	Immediate (or on travel)	Card, ePay	Pre & Post Pay (Pay as you go)	Acquire, top up / purchase etc

Department for Transport

#7.3: UK Bus – Payment Methods?

	PAYMENT METHOD	Subscription/ Top up	Note
ANONYMOUS	Cash	x	£
	Cash – Coins only	x	
ELECTRONIC / MOBILE	EMV Card	✓	Self print / store on mobile device
	ePay	✓	
	SMS	x	
OTHER	Bank transfer	✓	Use for Season Passes, Auto top up, & Subscriptions
	Cheque	x	Eg. For Season Passes
	Coupon / Voucher	x	E.g. for promotions

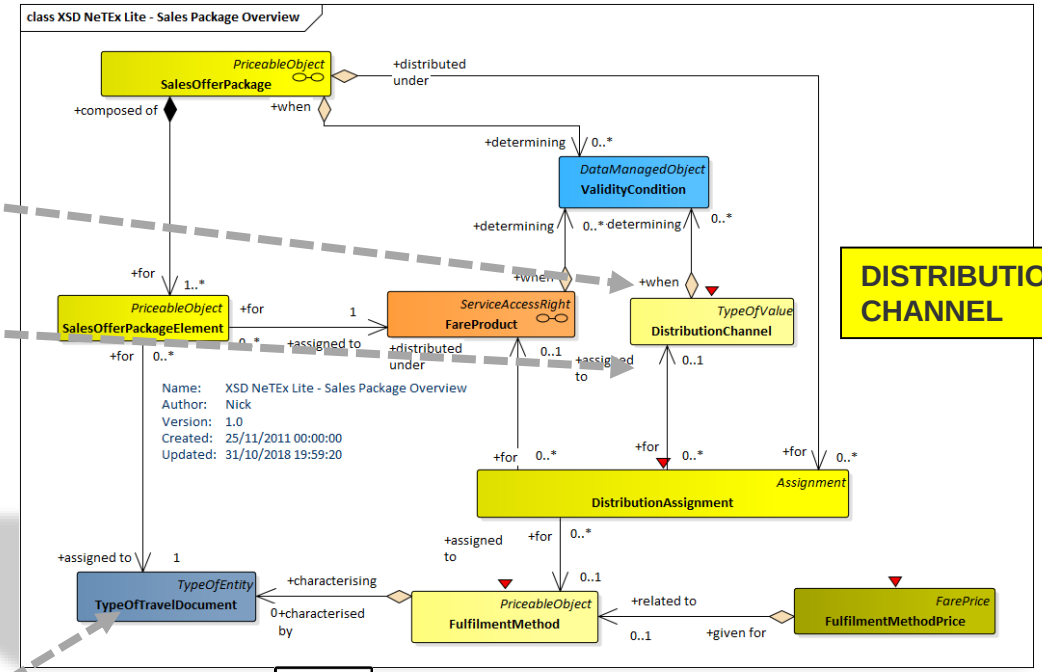
Bus – Offer: Fulfilment Methods

Type of method	FULFILMENT METHOD	Note
COLLECT	**Collect from driver or conductor**	Basic products
	Collect at counter	E.g. for Season passes,
	Collect at Machine	Not all products
	Collect at shop	Basic products
REMOTE DOWNLOAD	**Download to device**	App or pdf eticket
	Self print	Self print to paper
	email	Online & call centre purchases
	SMS	Online purchases
DESPATCH	**Post**	E.g. For Season Passes
	Courier	E.g. Online - Extra fee

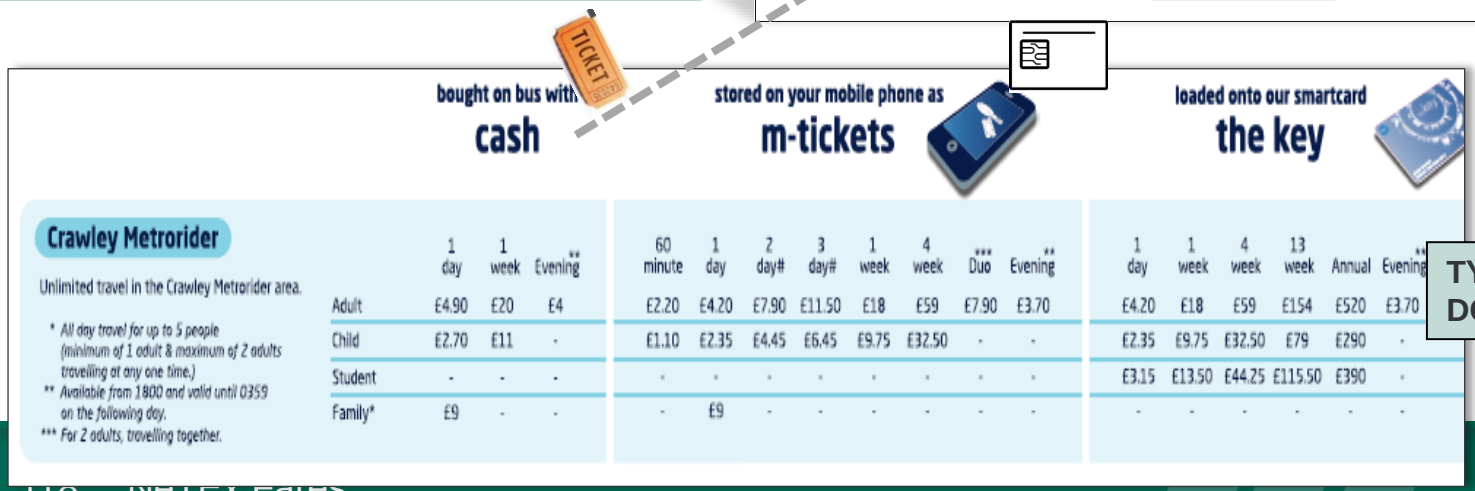
Department for Transport

Adding Distribution Parameters

PAYMENT METHOD

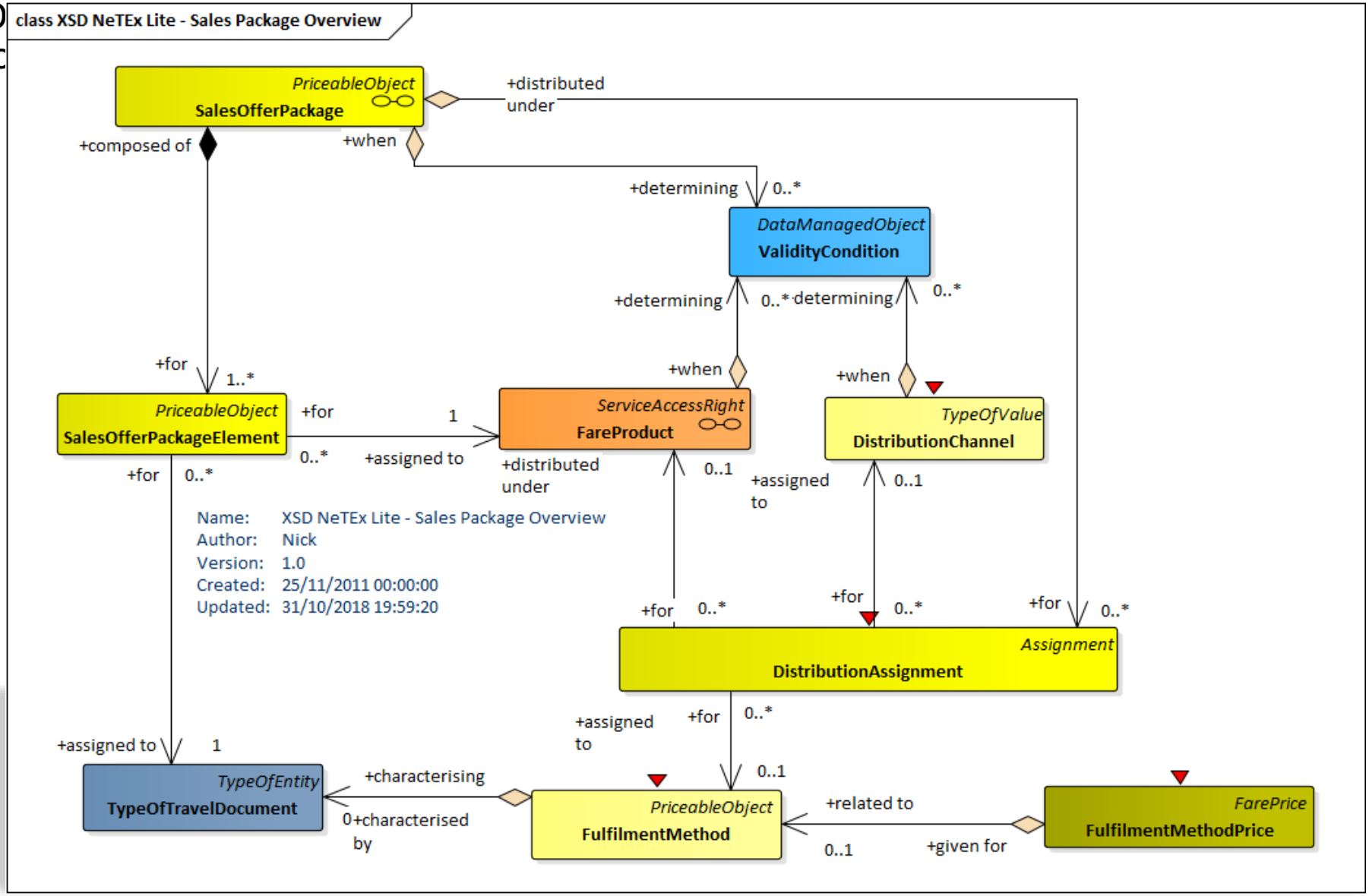


DISTRIBUTION CHANNEL



TYPE OF TRAVEL DOCUMENT

D
fc


class XSD NeTEx Lite - Sales Package Overview
PriceableObject
SalesOfferPackage
+distributed under
+composed of
+when
+determining
0..*
DataManagedObject
ValidityCondition
+determining
0..*
determining
0..*
+for
1..*
+when
+when
PriceableObject
SalesOfferPackageElement
+for
1
ServiceAccessRight
FareProduct
TypeOfValue
DistributionChannel
0..*
+assigned to
+for
0..*
+distributed under
0..1
+assigned to
0..1
Name: XSD NeTEx Lite - Sales Package Overview
Author: Nick
Version: 1.0
Created: 25/11/2011 00:00:00
Updated: 31/10/2018 19:59:20
+for
0..*
+for
0..*
+for
0..*
Assignment
DistributionAssignment
+assigned to
+for
0..*
+assigned to
1
0..1
TypeOfEntity
TypeOfTravelDocument
+characterising
0+characterised by
PriceableObject
FulfilmentMethod
+related to
0..1
FarePrice
FulfilmentMethodPrice
+given for

Department for Transport

Representing sales and distribution options in NeTEx

- User Types
- Group Tickets

Department for Transport

Further Aspects of Modelling Fares

Prices

Department for Transport

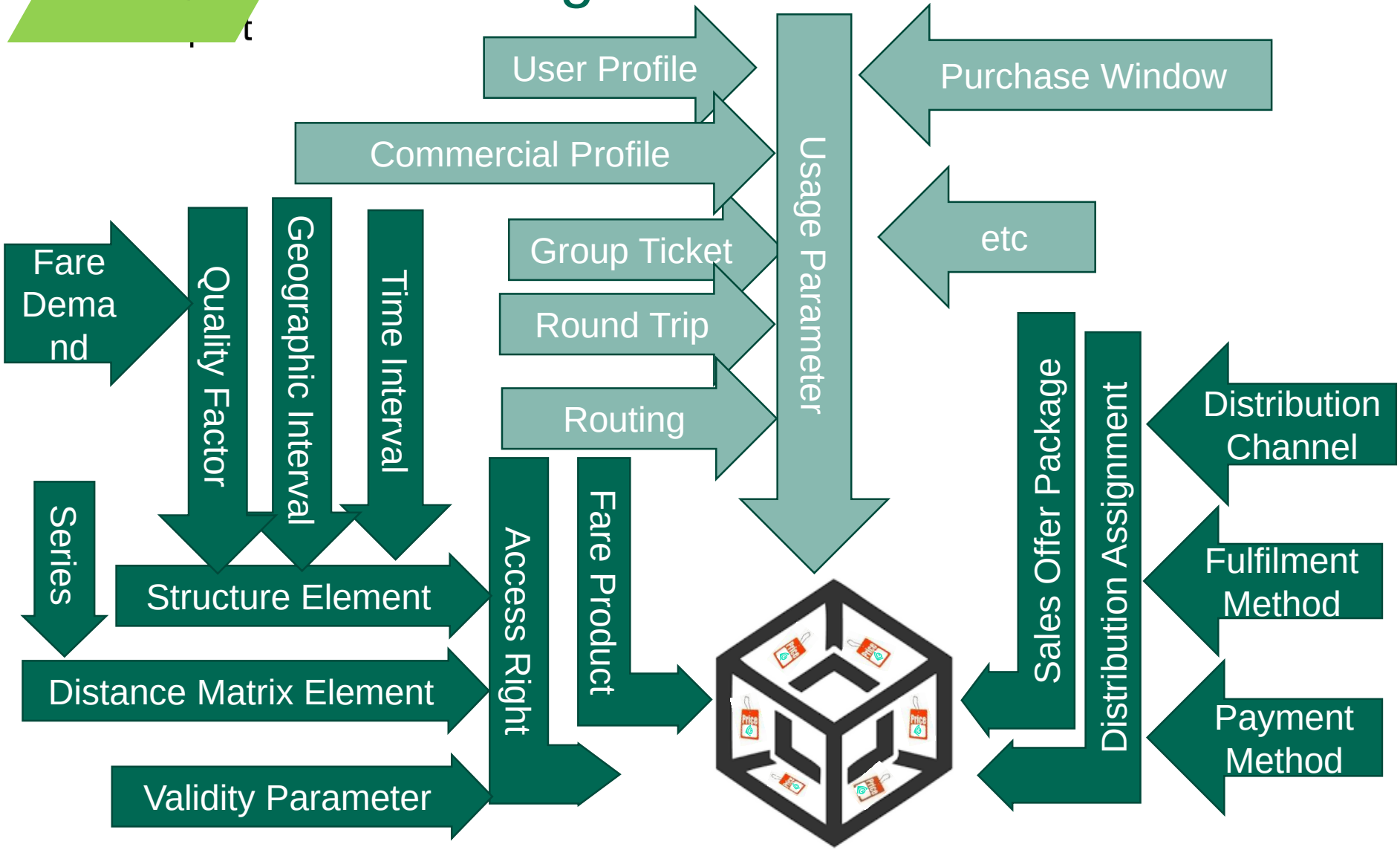
Fare Prices

- Prices are separate from the tariff elements they price.
  - An element may have different prices with different validities.
  - Prices may apply to individual elements or combination of priceable elements

- Different type of prices
  - Static / Base Prices
  - Prices Derived from Base Prices
  - Dynamic Prices (pricing service)
    - Range bands for dynamic prices can be indicated by FARE QUOTA FACTORs

Pricing

Pricing Dimensions



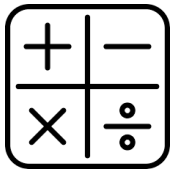
Department for Transport

PRICEs - Basics

- Prices are separate from the things they price
  - This allows them to be changed and exchanged sepaartely
  - There may be many prices for a given element,
  - Different prices may have different validities
- Various Tariff and fare structure elements can be assigned fare price (s)
  - PRICEABLE OBJECTS include DISTANCE MATRIX ELEMENTs, TIME INTERVALS, GEOGRAPHIC INTERVALS, etc
  - Arbitrary Additional combinations of factors can be assigned to FARE STRUCTURE ELEMENTS and given a price
- The price is in a given PRICE UNIT (monetary or otherwise)
- The Price may be in a PRICE GROUP
- The price may be derived from another price using a PRICING RULE: the base price can be referenced
  - Parameters for the calculation can be stated e.g. ROUNDING RULES
  - When a prices is derived, the calculation steps may be recorded

Department for Transport

Pricing Rules

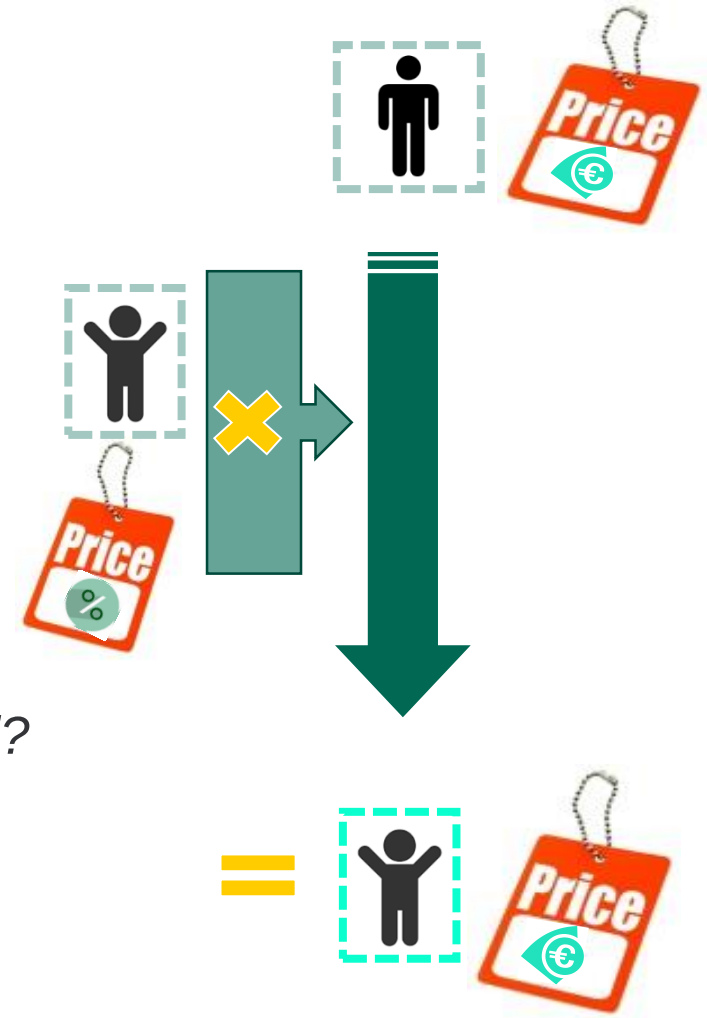


- Pricing rule
  - Any arbitrary named calculation
- Discounting rule
  - Price is a % discount
- Limiting discounting rule
  - Ount with absolute minima and maxima
- Rounding: Global parameter
  - Round to limit
  - Round in stepsAm

Department for Transport

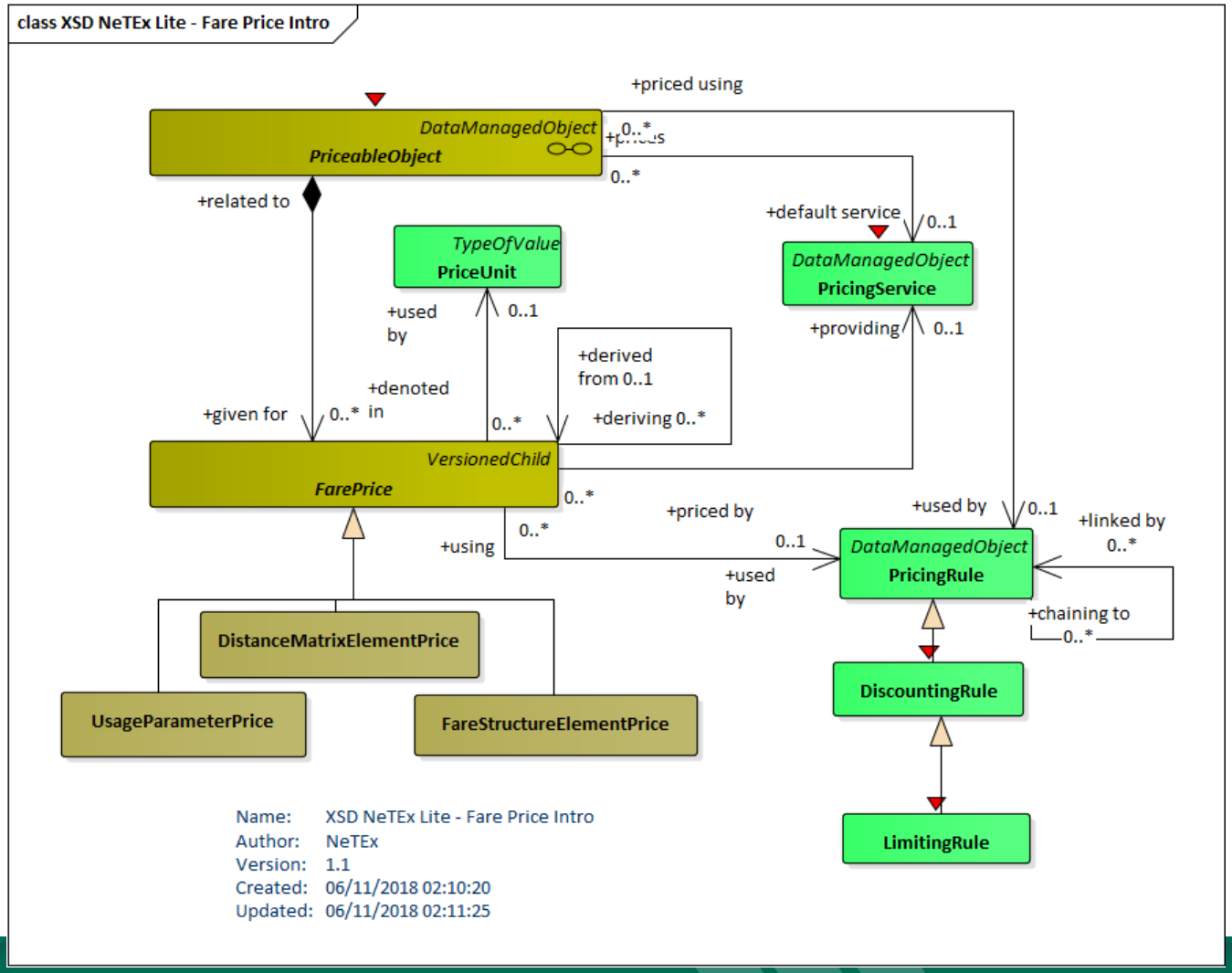
Prices may be absolute or derived

- **Base Price**
  - E.g. *Adult =£1.50*
- **Pricing Rule**
  - Discounting
    - E.g. *Child = 50% of Adult*
  - *Limiting*
    - *Minimum price = 50p*
  - *Cumulative discounts allowed?*
- **Derived Price**
  - *E.g. Child = £0.75*



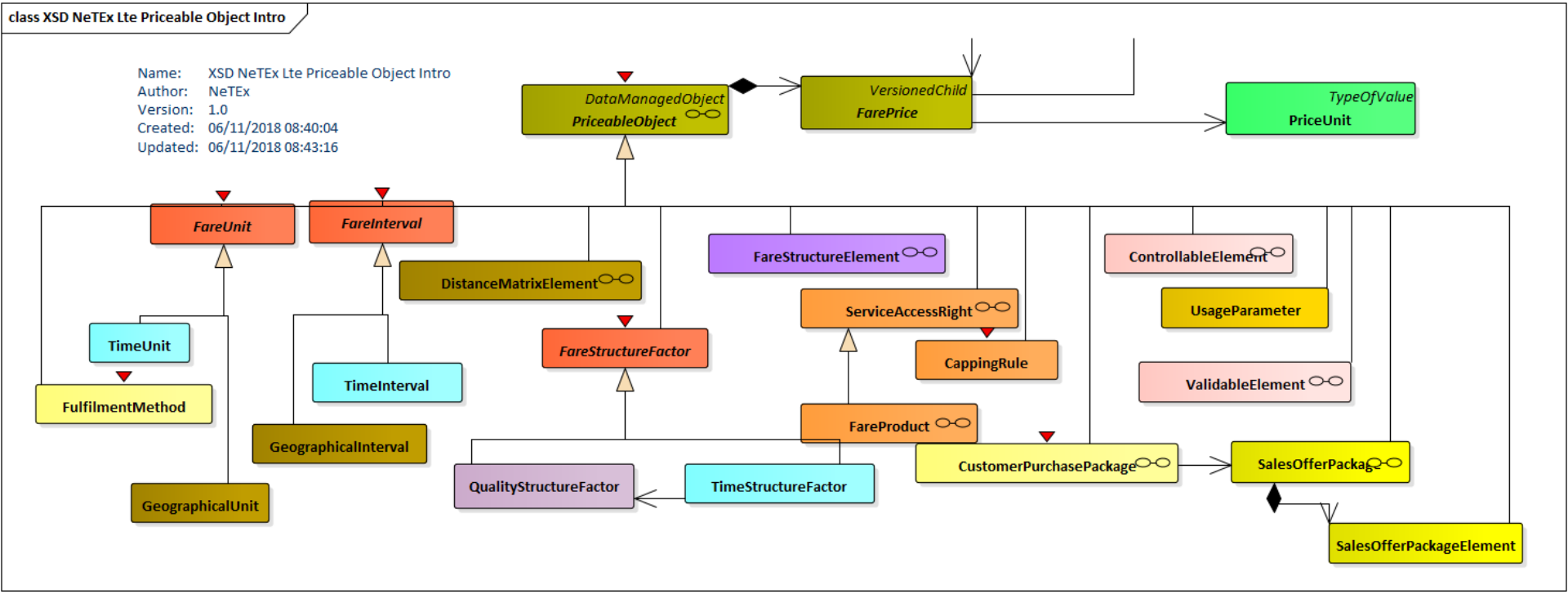
Fare Prices – can be associated with pricing rules

- Can be Dynamic
  - PRICING SERVICE



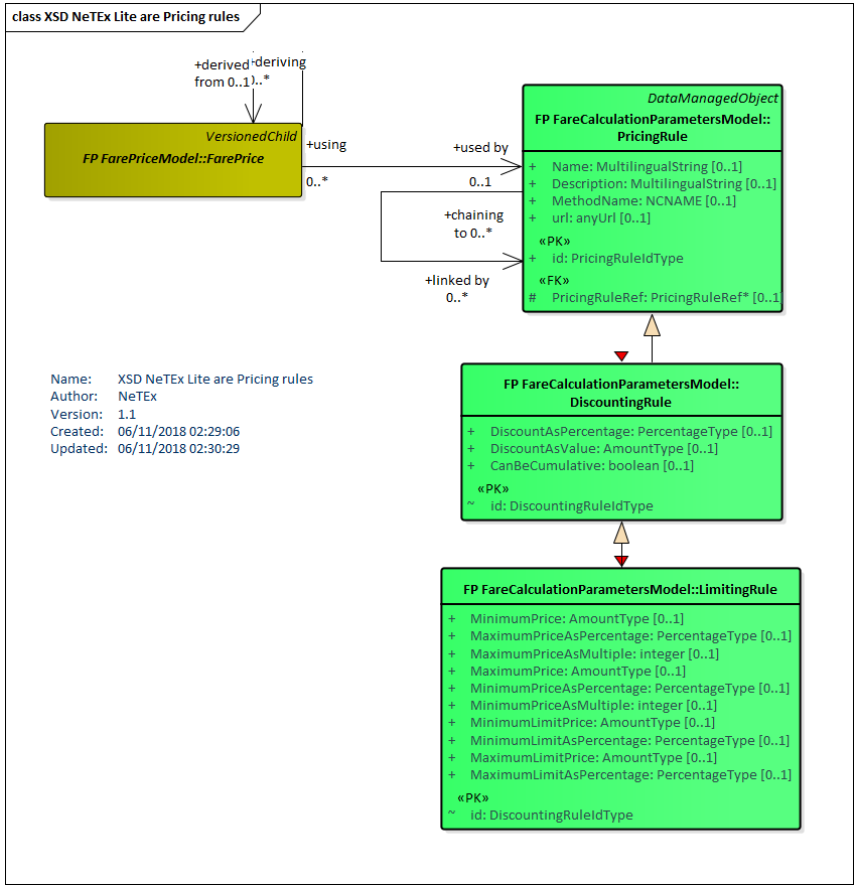
Department for Transport

Priceable objects



Department for Transport

Price Rules – Specify discounts etc

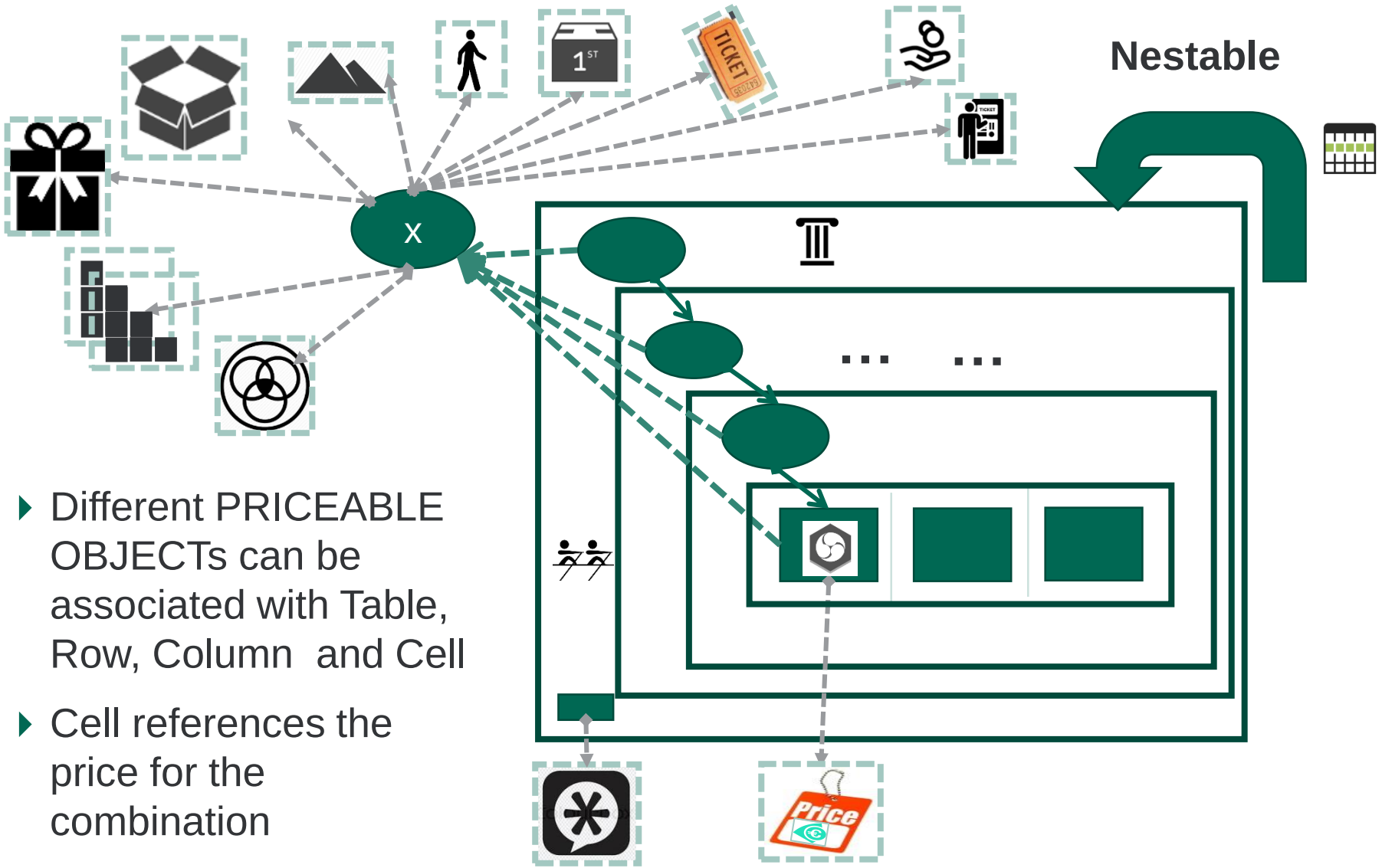


Department for Transport

Nesting Tables

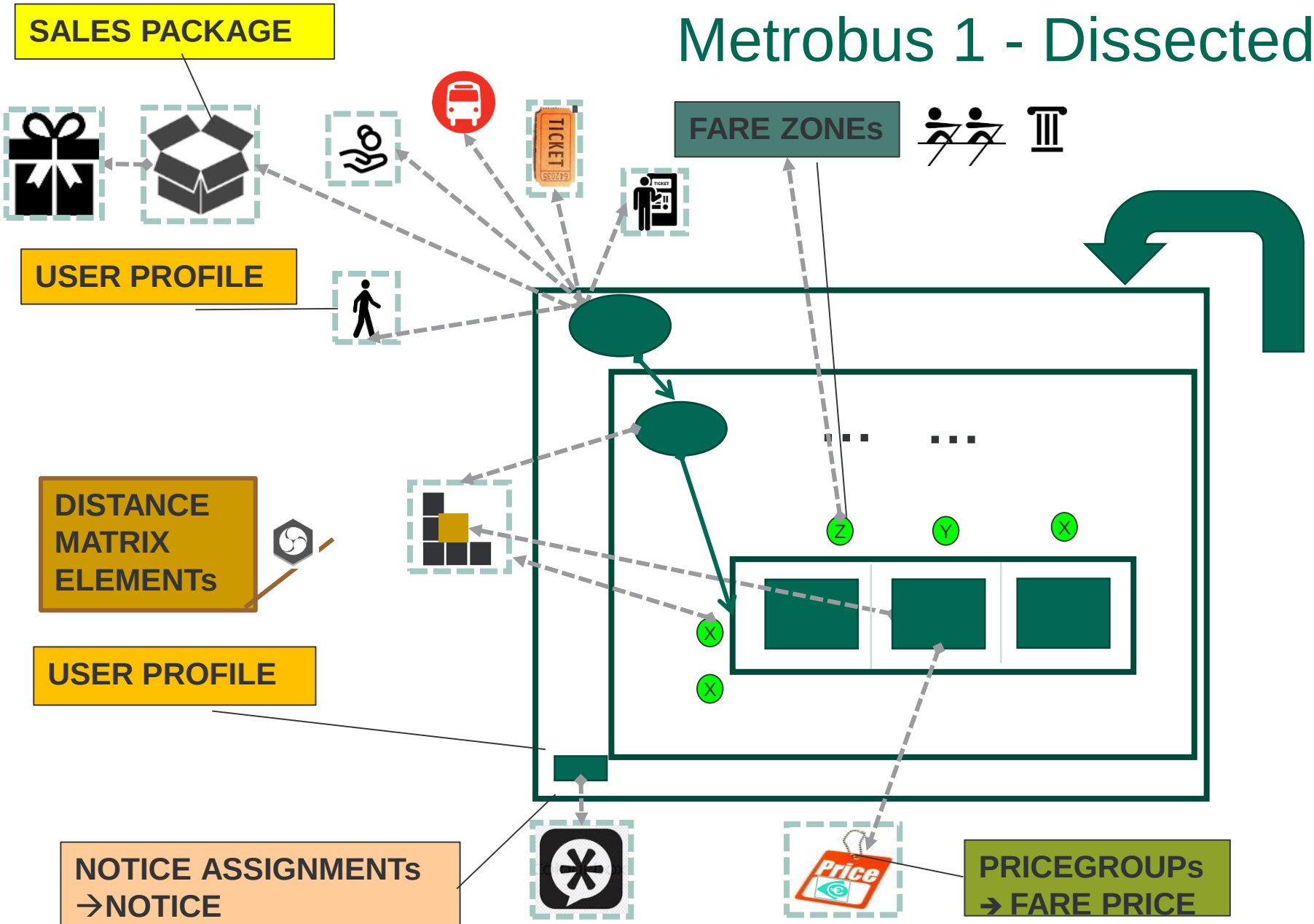
- Tables can eb nested
  - Efficient encoding in XML – Avoids repetition of common properties

Fare Tables – Organising Price Combinations



- Different PRICEABLE OBJECTs can be associated with Table, Row, Column and Cell
- Cell references the price for the combination

Metrobus 1 - Dissected

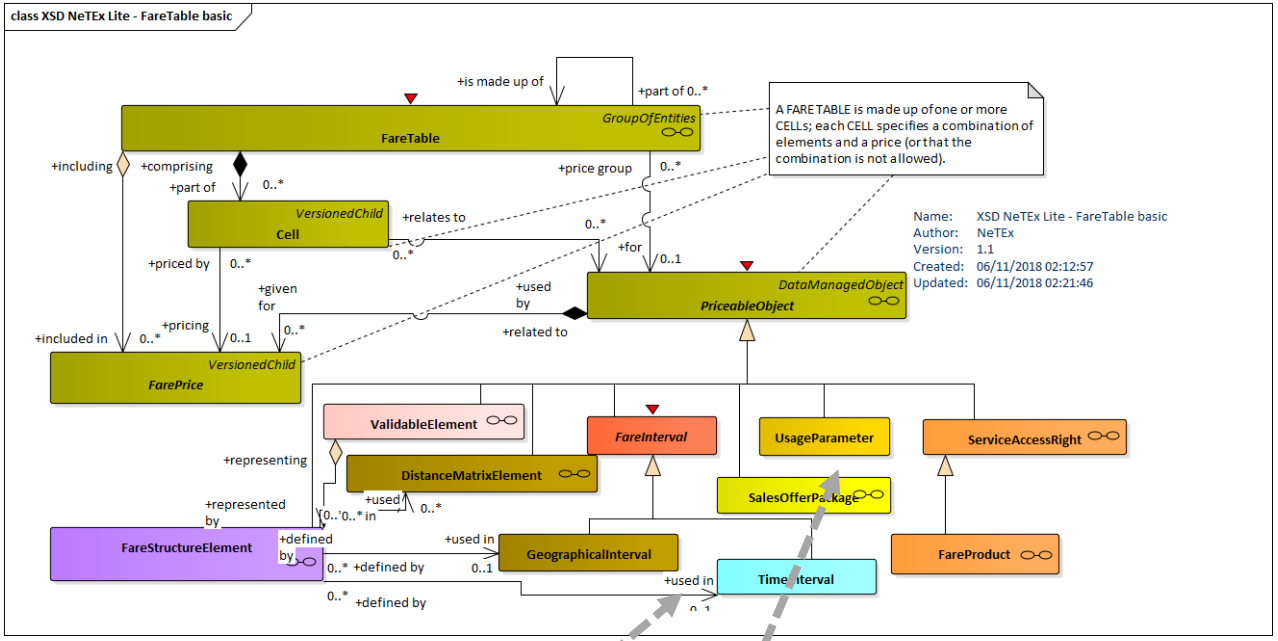


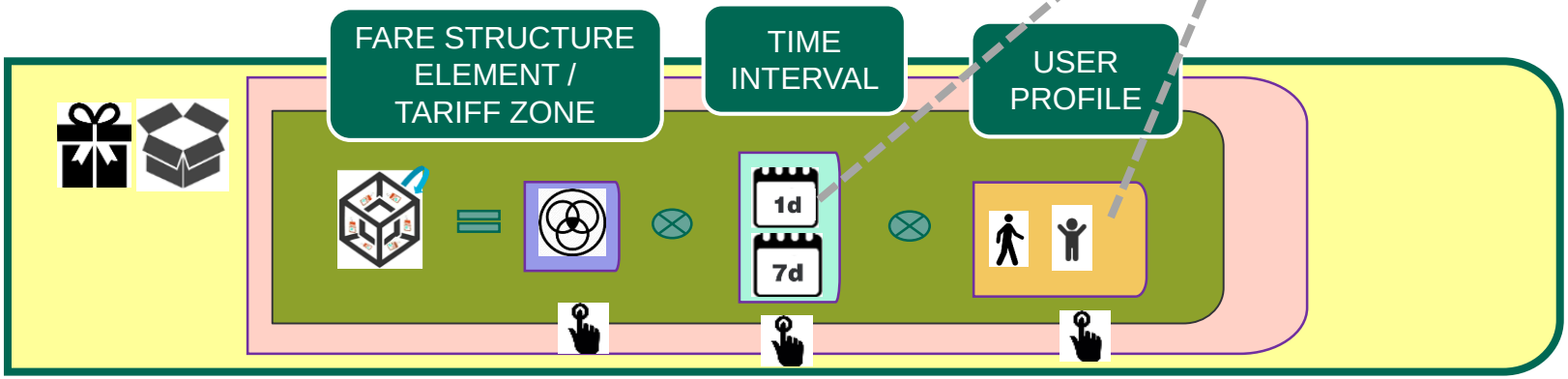
Department for Transport

Fare Table – Recursive Row/Column

- Each cell can refer to a price

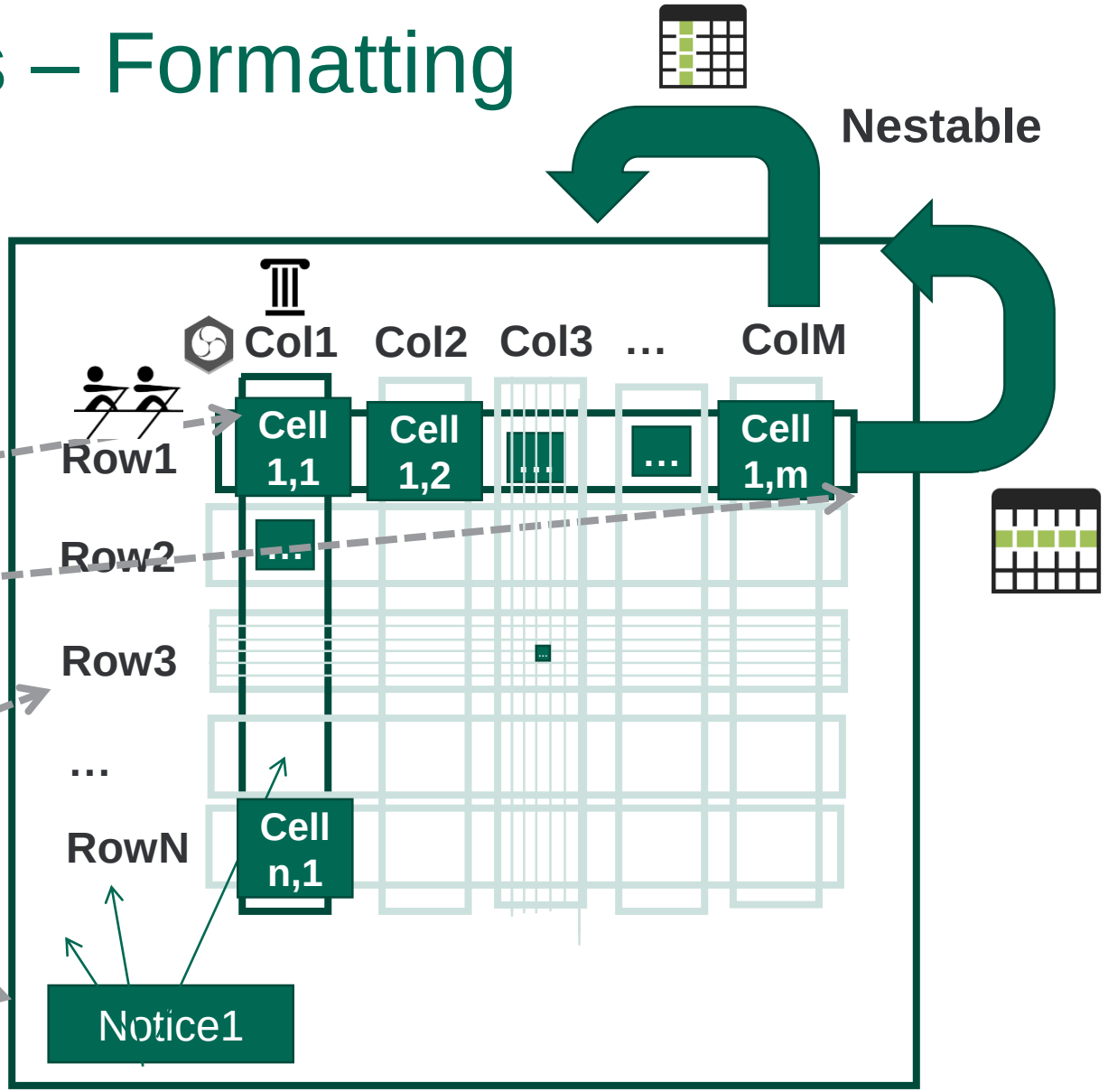
Prices - Allowed combinations





Fare Tables – Formatting

- **Presentation of fares in tabular form**
  - Table of price **cells**
  - Row or column can be another nested table
  - Can have row and column **headers**
  - **Notices** may relate to any element



Department for Transport

UK Bus Fares NeTEx Profile

UK Profile General Issues

Use existing where available

☑

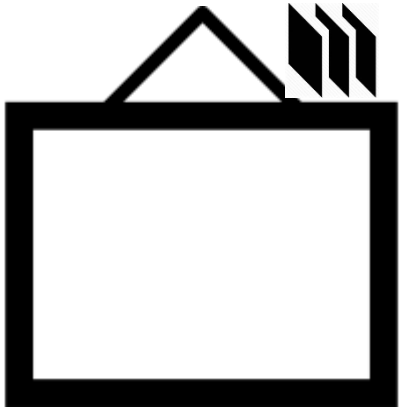
Allow for distributed allocation of ids by Operator.

Department for Transport

#8.1 : Data Identifiers ☑

- **Persistent Unique Identifiers for all components**
  - Allow for distributed allocation of ids by Operator.
  - Operator defines namespace as W3C URI
- Use existing where available ☑
  - Topographic localities ☑
    - NPTG
  - Stops ☑
    - NaPTAN,
  - Tariff Zones / Fare Stages ☑
    - PlusBus : (NPTG Already has)
    - Operator Defined Zones : Within NOC?
    - Local Authority Defined Zones : Within NPTG Admin code?
  - Operators ☑
    - NOC: Clarify process etc
    - LINES /SERvices
- **Most components must be unique within Operator:**
  - Lines, Timetables/Services, Tariffs, etc

Version Frames

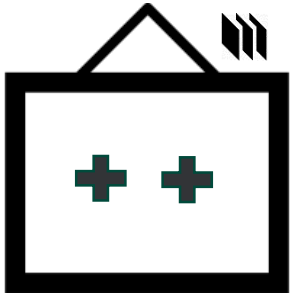


VERSION FRAME

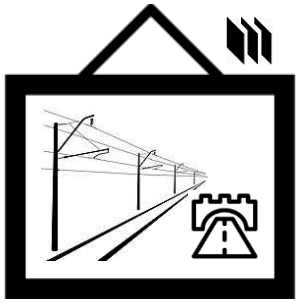
COMPOSITE FRAME

RESOURCE FRAME

SERVICE CALENDAR FRAME



GENERAL FRAME



INFRASTRUCTURE FRAME

SITE FRAME

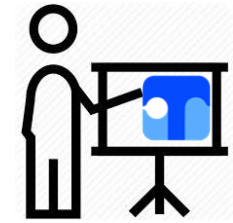
SERVICE FRAME

TIMETABLE FRAME

FARE FRAME

SALES TRANSACTION FRAME

Building on Existing data elements



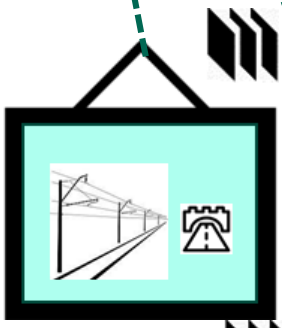
RESOURCE FRAMEs

SERVICE CALENDAR FRAME
(Day Types, etc)

FARE FRAME
(Products & Tariffs)

SALES TRANSACTION FRAMEs
(Purchases)

SERVICE FRAMEs
(Stops & lines etc)



TIMETABLE FRAMEs
(Products & Tariffs)

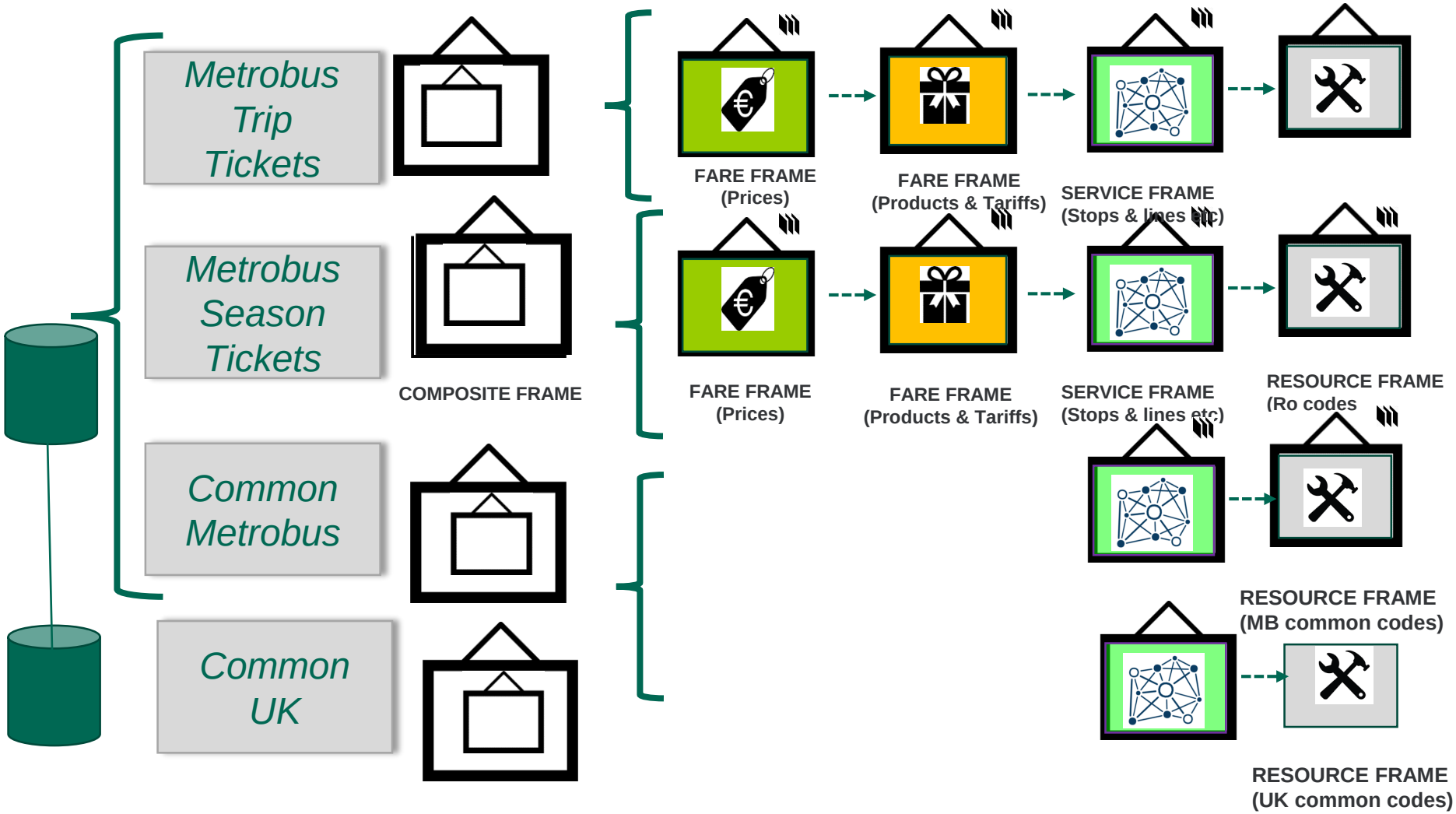
FARE FRAME
(Prices)

COMPOSITE FRAME
Grouping

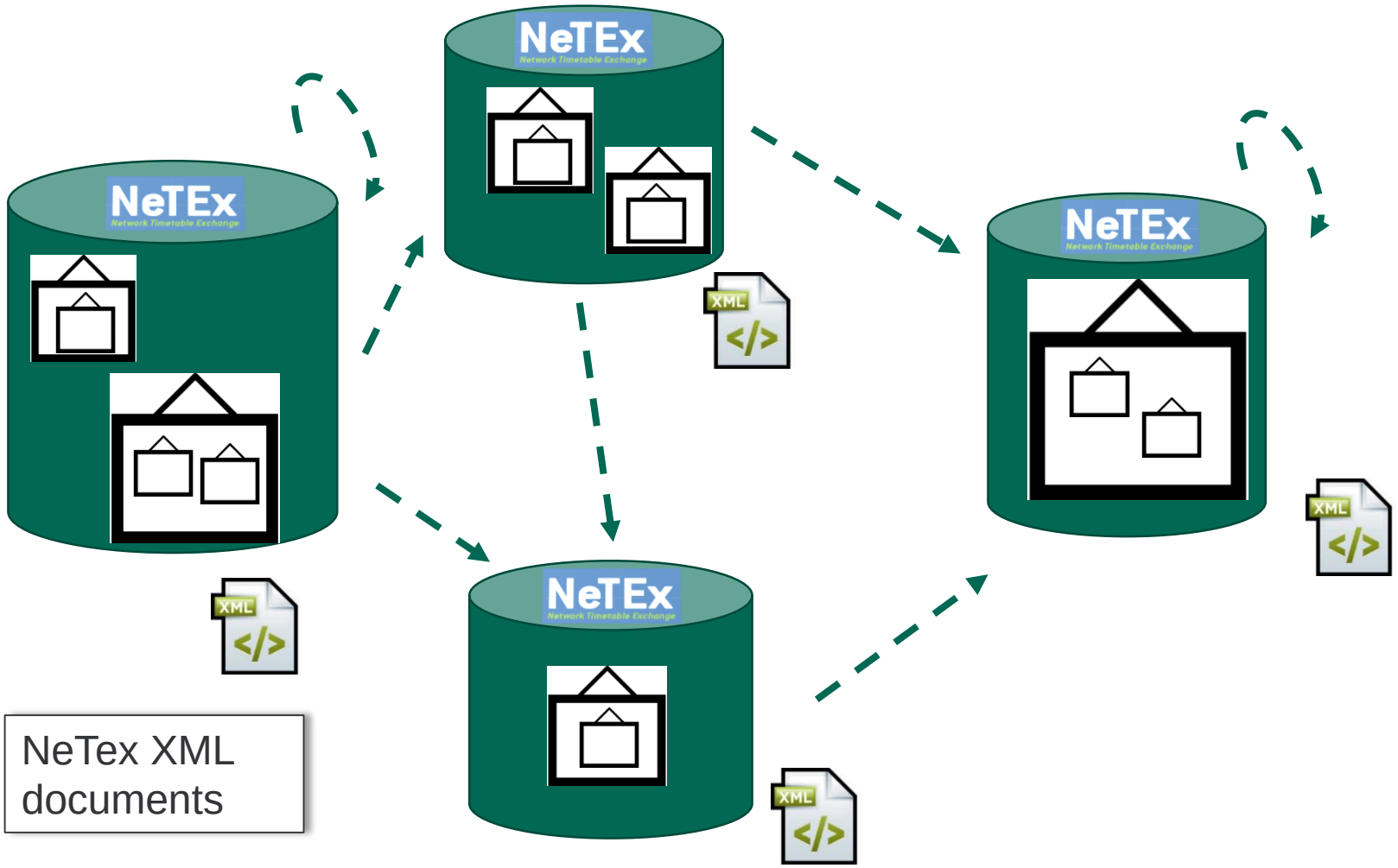
SITE FRAME
(Physical Stops, Accessibility. etc)

Department for Transport

Organising Tariffs, Products and Prices with Frames



Modularise ; references may be internal or external



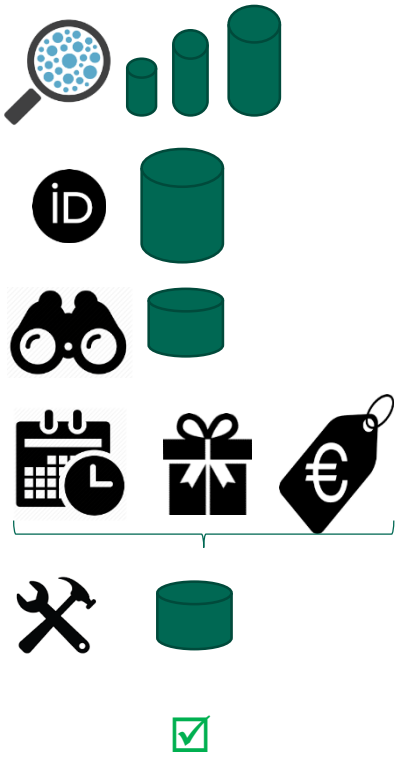
Department for Transport

#8.2: Validation

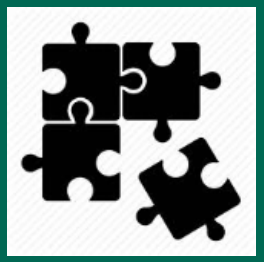
- **Validation Mechanisms**
  - Schema integrity rules ☑
  - Code lists ☑
  - Additional business rules to program? ?
- **How do we check all of the above are met?**

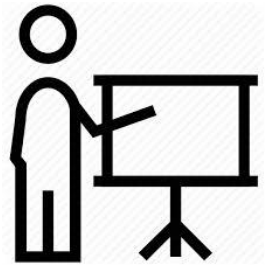
Department for Transport

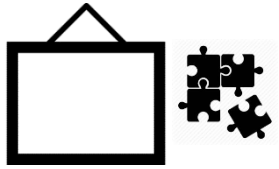
#8.3 : Data Management ☑



- Granularity
  - Service, Line, Operator, Region, etc
- Allocating systematic File names?
  - E.g. Operator_Service_Line_ StartValidityDate….
- Discovery Processes?
  - Active registration / Passive Indexing
- Synchronising Timetable & Tariff updates
- Validation criteria ?
- Validation tools
  - Schema,
  - Additional Program?, Fare “publisher”? +
- Etc







Example 1
Common Framework

Department for Transport

Frame Defaults – apply to all contents (unless overridden)

```
<CompositeFrame version="1" id="uic:DistanceTariff_Example">
                        <Name>Example of Distance Based Tariff</Name>,
…
        <codespaces>
                        <Codespace id="uic"> <!--- ======= CODESPACEs======== -->

                                <Xmlns>uic</Xmlns>
                                <XmlnsUrl>http://www.uic.org/</XmlnsUrl>
                                <Description>UIC data</Description>
                        </Codespace>
                        <Codespace id="era">
                                <Xmlns>era</Xmlns>
                                <XmlnsUrl>http://www.era.eu/codes</XmlnsUrl>
                                <Description>European Rail Authority</Description>
                        </Codespace
                        <Codespace id="tfc">
                                <Xmlns>tfc</Xmlns>
                                <XmlnsUrl>https://www.transferoviarcalatori.ro/</XmlnsUrl>
                                <Description lang="ro">Transferoviar Calatori/</Description>
                        </Codespace>
        </codespaces>
        <FrameDefaults>

                        <DefaultCodespaceRef ref="tfc"/>
                        <DefaultCurrency>LEI</DefaultCurrency>
        </FrameDefaults>
…….
        <frames>
                        <ServiceFrame id="tfc:Tariff" version="any" modification="revise">
```

Reusable Framework Components

TGV, ICE, RE…

- Organisations
  - Operator (RU)
  - Country
- Units
  - Kilometers, Currency
- Value Sets (Use to establish common EU values)
  - Train categories
  - Seat Classes (first, second, etc)

Department for Transport

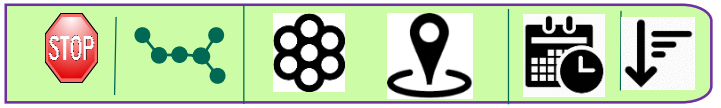
Summary?

Common Framework

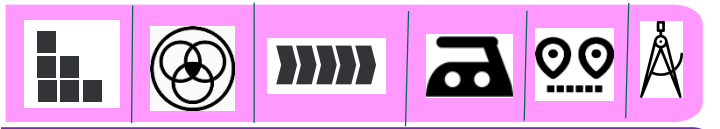
Describing Fares with NeTEx

Pricing

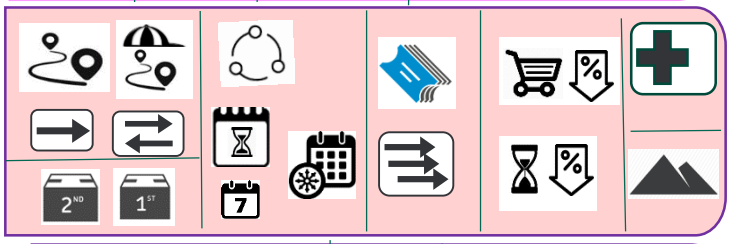
Network Basis



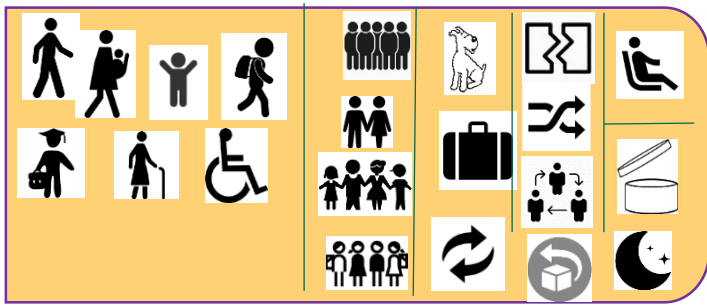
Tariff Structure



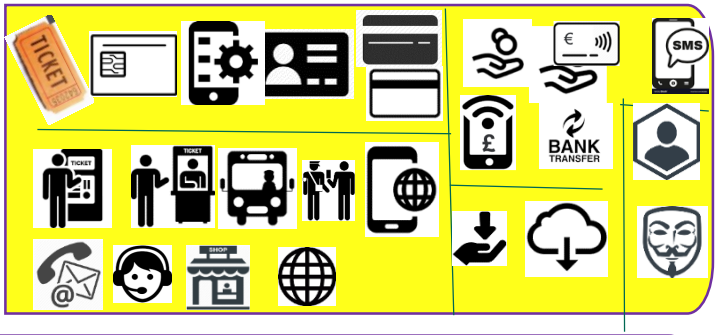
Access Rights



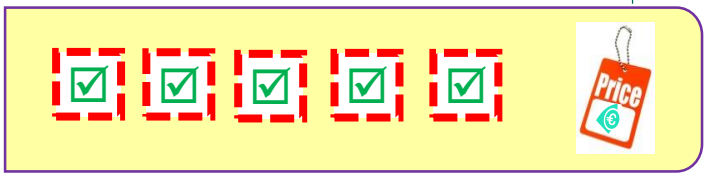
Fare Products



Sales Offer Packages



Travel Specifications & Sales



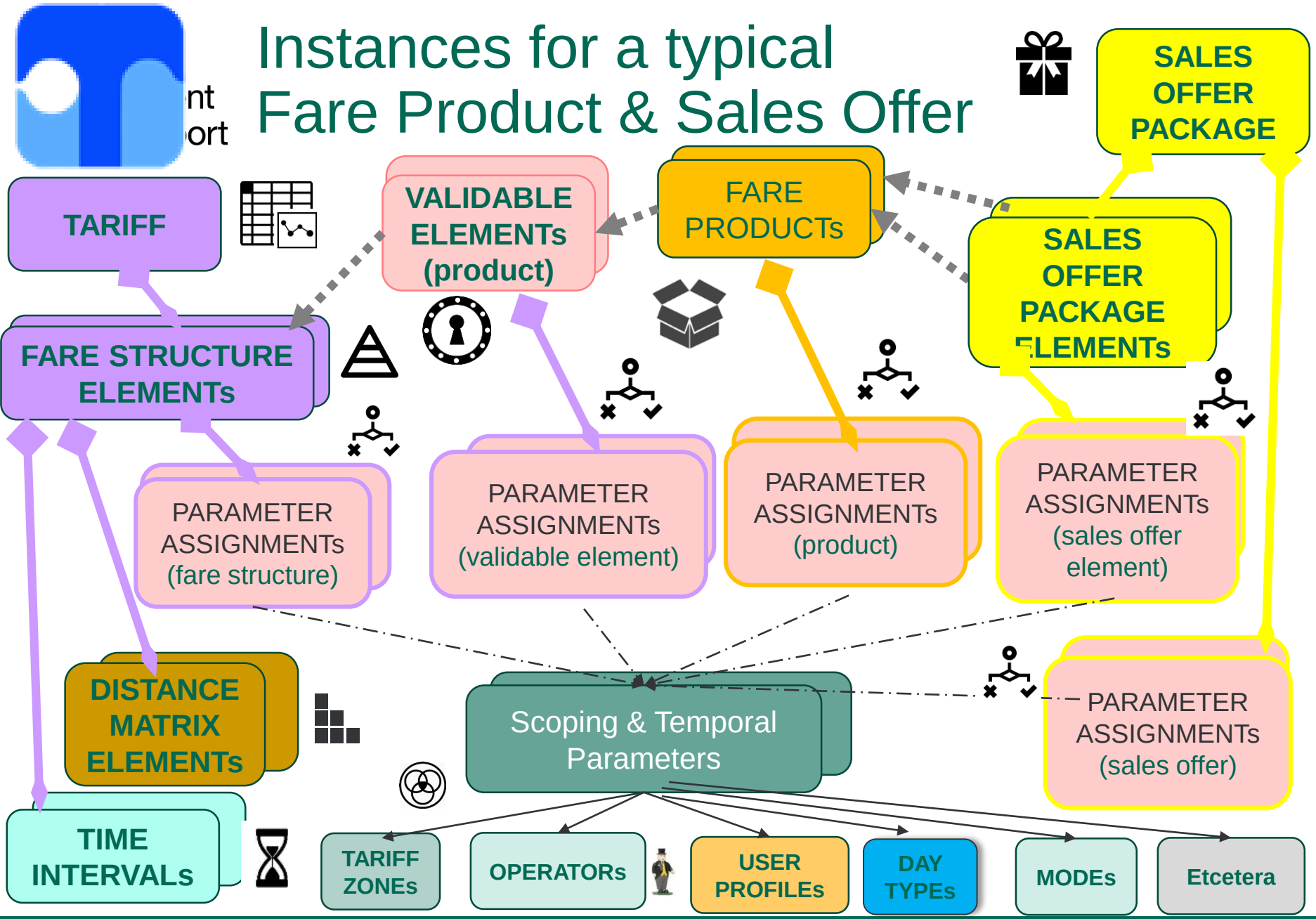
Basic UK Bus fare tariff types?

Department for Transport

Access rights		Tariff Structure						
Type of Product	PREASSIGNED FARE PRODUCT	Flat	Point to point	Named Zones	Zone/ Stage Count	Peak / Off Peak	Group Ticket	Temporal Conditions
TRIP *("single ride")*	*Short hop*	☑	☑	☑	☑	?	-	No break
	Single trip	☑	☑	☑	☑	☑	☑	Has use by date?
	Time-limited ("Hopper")	-	-	☑	-	☑	☑	Max trip duration, Can interchange
	Period Return	☑	☑	☑	-	☑	☑	Has use by date?
	Day return	☑	☑	☑	-	☑	☑	Must use same day
PASS	*Day pass*	-	-	☑	-	☑	☑	1D (elapsed or calendar)
	Termtime	-	?	☑	-	-	-	Use during term 1Y
	Season pass	☑	☑	☑	-	-	-	n x D,W,M, 1Y

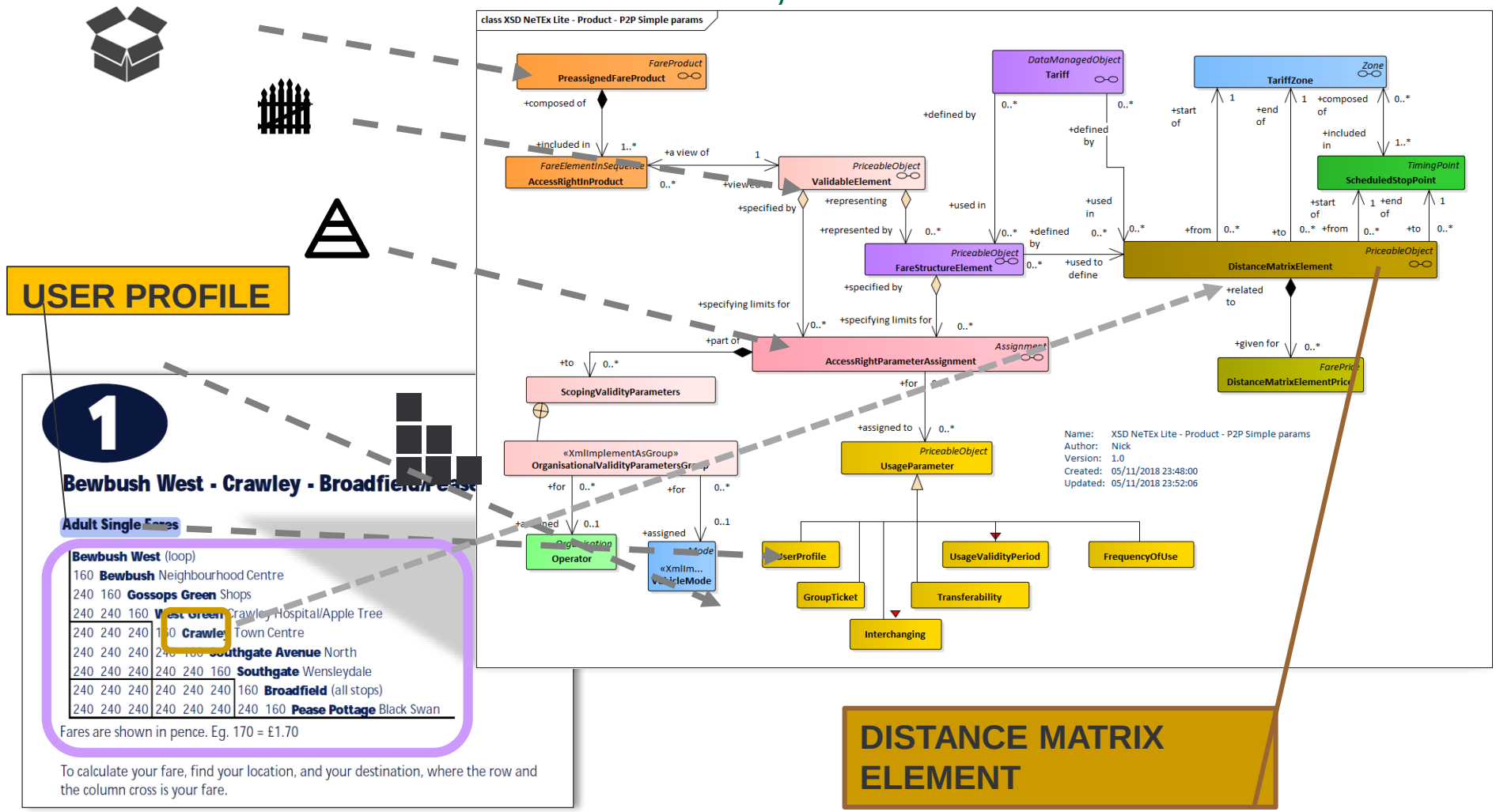
Metrorider zone

Instances for a typical Fare Product & Sales Offer



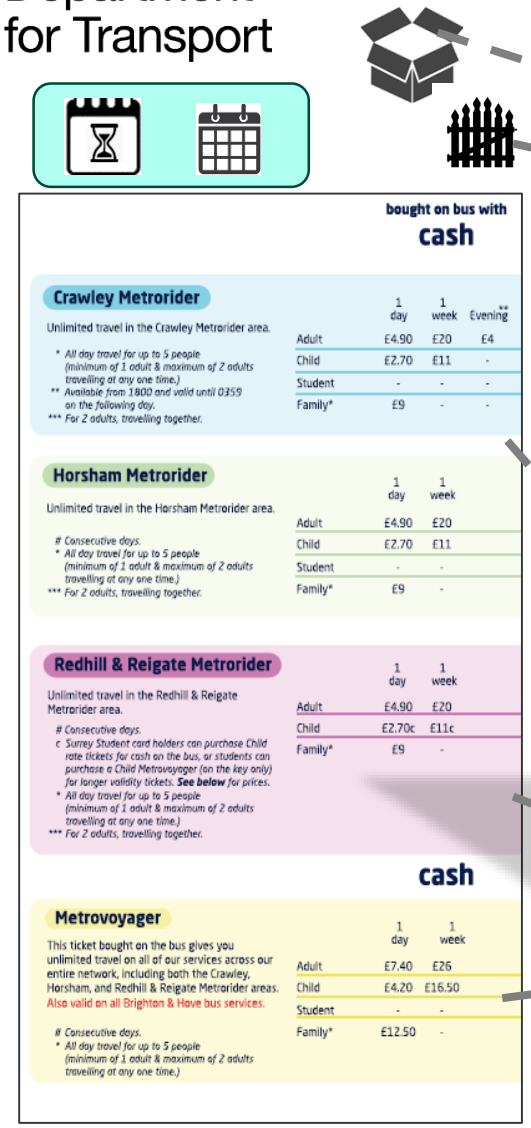
Department for Transport

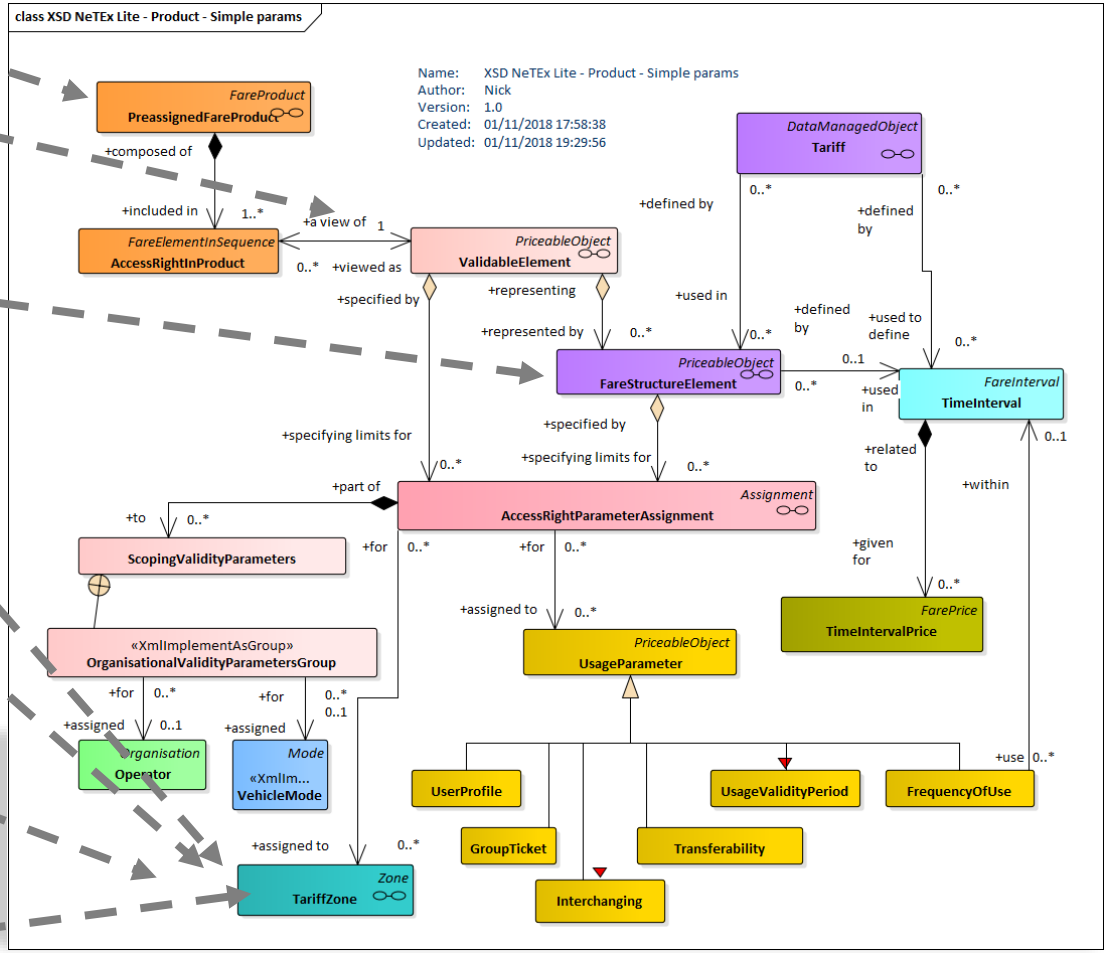
A Zone to Zone Product: Use DISTANCE MATRIX + Assign OPERATOR, MODE, USER PROFLEs, etc



A Season Pass Product : Assign FARE ZONEs + OPERATOR, MODE, & USER PROFILEs

Department for Transport





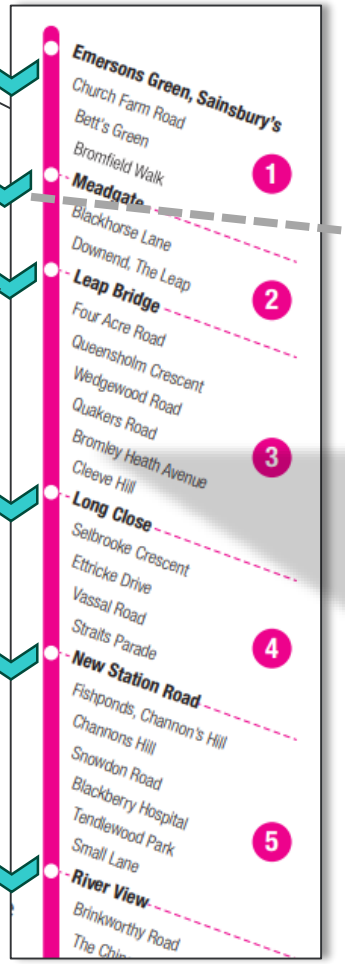
Department for Transport

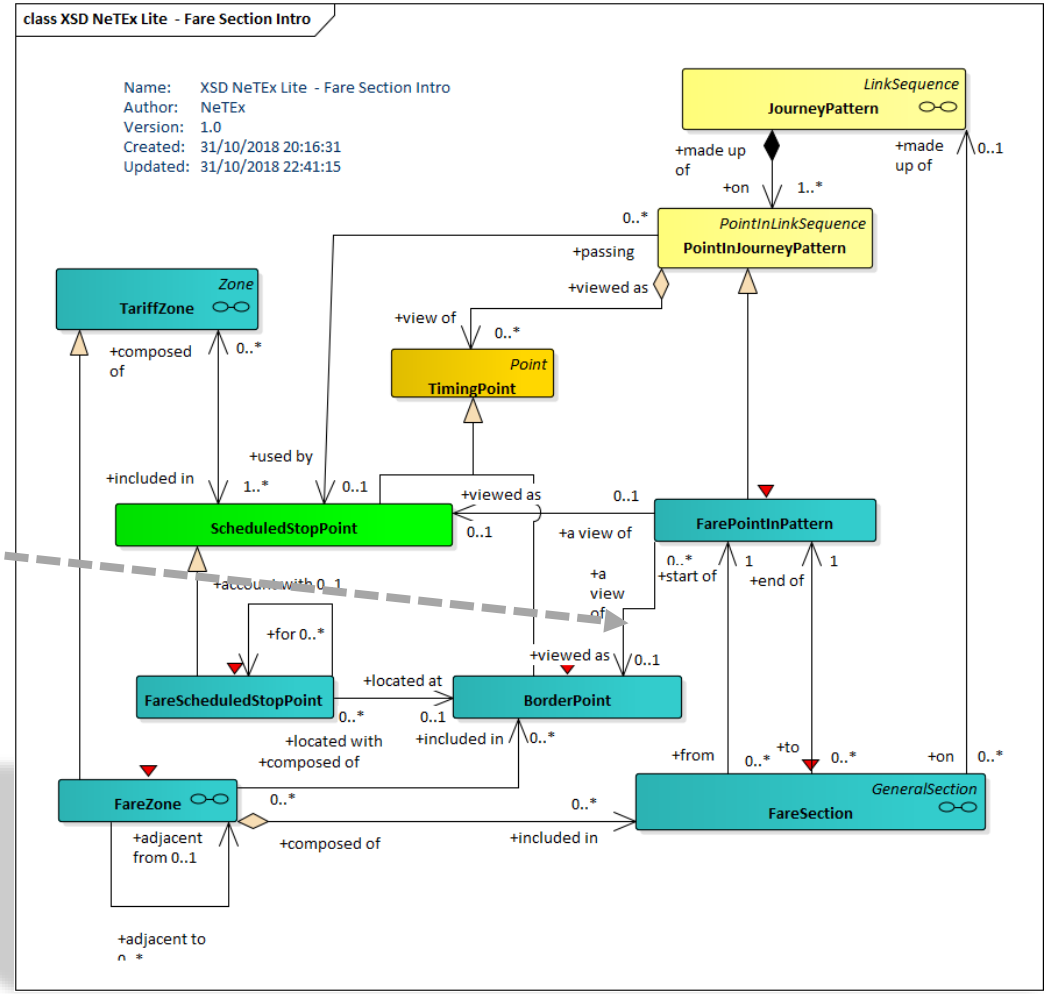
Modelling – Stage definitions

SCHEDULED STOP POINTs

FARE POINT IN PATTERN

FARE SECTIONs

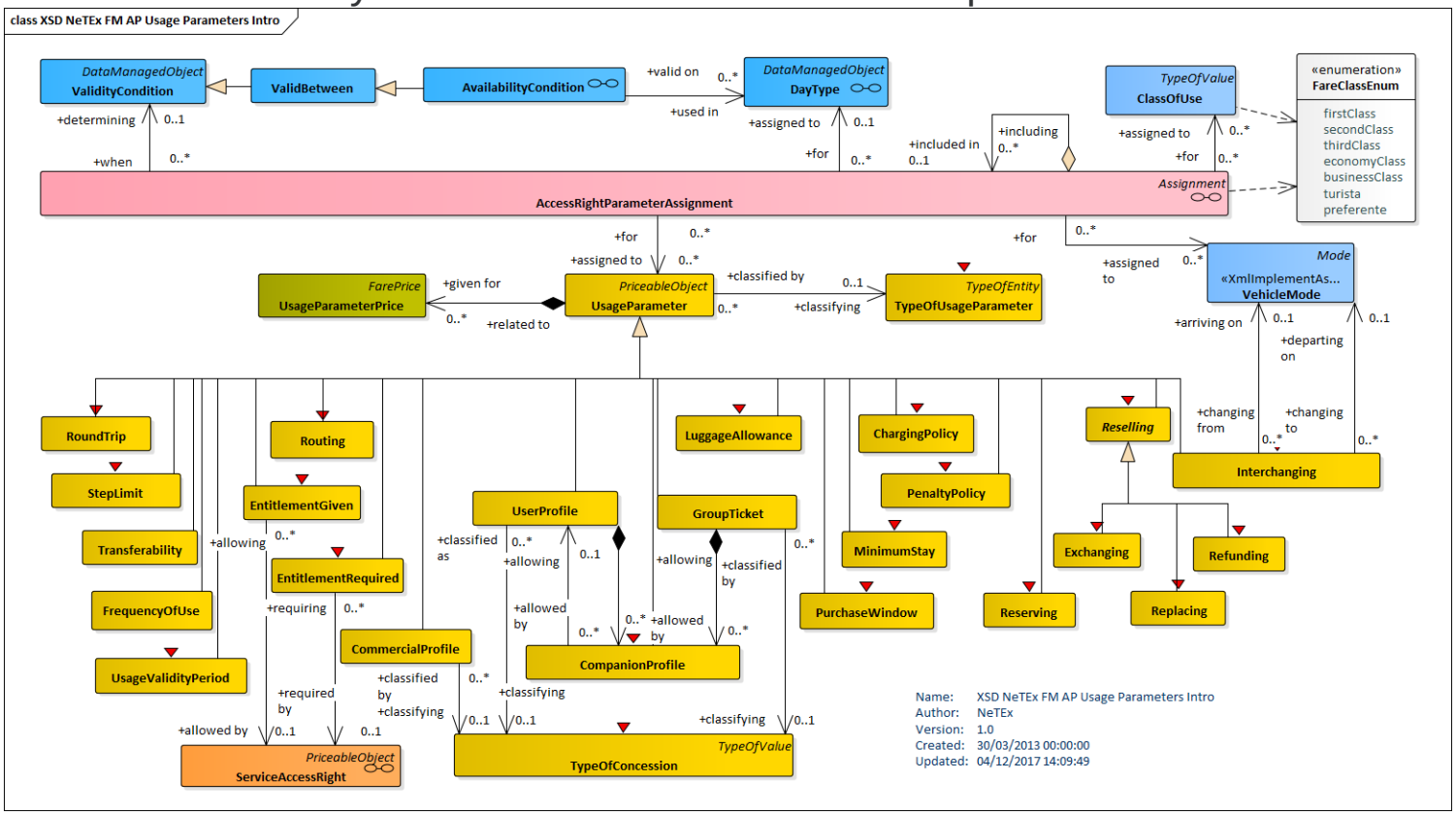




- Dynamic zone counting : Trip planner uses JOURNEY PATTERN to determine number of FARE SECTIONs traversed between origin and destination POINT IN PATTERN

USAGE PARAMETERs - Summary

- Easy to extend with new attributes or parameters



Department for Transport

Benefits of Transmodel /Netex ApproachTransmode

- **Powerful Component based representation**
  - Allows many different tariff combinations to be described with the same set of atomic components
  - Allows complex conditions to be expressed
  - Allows necessary packaging distinctions to be made
  - Gives Highly reusable implementation
- **Joined up conceptual model - Reuses existing network & Timetable elements**
  - network & (Stops, tariff zones, modes, operators
  - Timetable elements, day types)
  - Temporal conditions and day types, validti
- **Robust, Flexible, Extensible Technology**
  - XML allows selective use, validation integrity checking etc

Department for Transport

Some Drawbacks

- **Intial effort needed to understand Terminology, Concepts & Components**
  - Tariff structures, Access rights
  - Uses of different parameters
  - Product and Sales Offer packaging
- **Component based semantics require attention to assembly and compound behaviour**