### Fares and NeTEx Workshop

**Manchester**

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

November 2018
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
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
#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 **separate 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**. ✓
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.
Profile Scope - #3 Prices?

▶ What Prices are needed?

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

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

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

4. **Price Groups?**
   - Where Price is common to several elements
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)
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 Structures
  - Distance Matrix Elements
  - Products
  - Tariff Prices
  - O/D x product/user type/ x x price

- **GTFS Fare Rules Translation?**
A Strawman for the UK Bus Fare Profile

Basic UK Profile
Advanced UK Profile
Exclude / Long term roadmap
Agenda for Discussing Scope

- 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 needed
  - Base, Derived, Dynamic
### Basic UK Bus fare products?

<table>
<thead>
<tr>
<th>Type of Product</th>
<th>TRIP (&quot;single ride&quot;)</th>
<th>PASS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREASSIGNED FARE PRODUCT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Type of Product</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point to point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Named Zones</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone/Stage Count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak/Off Peak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group Ticket</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporal Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Access rights</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tariff Structure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Short hop</strong></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Single trip</strong></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Time-limited (“Hopper”)</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Period Return</strong></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Day return</strong></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Day pass</strong></td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Termtime</strong></td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Season pass</strong></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### Access rights:
- **TRIP ("single ride")**
  - Short hop: ✓
  - Single trip: ✓
  - Time-limited (“Hopper”): -
  - Period Return: ✓
  - Day return: ✓

### Temporal Conditions:
- 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

### Tariff Structure:
- Short hop: ✓
- Single trip: ✓
- Time-limited (“Hopper”): -
- Period Return: ✓
- Day return: ✓
- Day pass: ✓
- Termtime: ✓
- Season pass: ✓
### More complex UK Bus fare products - Carnets: Multi-trip / Multi-pass offers

<table>
<thead>
<tr>
<th>Type of Product</th>
<th>Quantity</th>
<th>Related tariff structure</th>
<th>Temporal Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CARNET</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-trip</td>
<td>✔️</td>
<td>Any individual Trip</td>
<td>Trips have use-by date Trips can be time limited</td>
</tr>
<tr>
<td>Multi-Day pass</td>
<td>✔️</td>
<td>Day Pass</td>
<td>Passes have specified duration Passes have use-by date</td>
</tr>
</tbody>
</table>
The Basic Bus Fares

<table>
<thead>
<tr>
<th>Single Trip</th>
<th>Zonal</th>
<th>Period Pass</th>
<th>Carnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bewbush West - Crawley - Broadfield/Pease Pottage</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>Adult Single Fares</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>160 Bewbush Neighbourhood Centre</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>240 - 240 160</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>West Green, Crawley Hospital/Apple Tree</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>Crawley Town Centre</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>240 - 240 160 160</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>Southgate Avenue North</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>240 - 240 240 - 240</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>190 Broxbourne (all trips)</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>240 - 240 160</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
<tr>
<td>Fares are shown in pence. Eg: £0.70 - £1.70</td>
<td>Crawley Area Metro rider</td>
<td>Horsham Metro rider</td>
<td>Redhill &amp; Reigate Metro rider</td>
</tr>
</tbody>
</table>

To calculate your fare, find your location, and your destination, where the row and the column cross is your fare.

Return Fares Not available on this service.

Child Fares Child Fares are available on this route at half the adult fare.

Crawley Area Metro rider

<table>
<thead>
<tr>
<th>Distance-based fares for the West of England</th>
<th>How is your journey fare calculated?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crawley Town Centre</td>
<td>Distance is calculated using fare stage sections rather than individual bus stops, with each section being approximately one mile long</td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

For further information, including Gatwick information on the key, and the Haywards Heath Day Saver, and Burgess Hill Day Saver, please see the fares pages on our website.
Network & Timetable elements needed to define Tariff Structures

- Network Journey & Timetable Elements
Network elements for tariff and product definition

- Fare structures build on NeTEx Part 1 & Part 2 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
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)
OPERATOR – As in TransXChange

XML Code Snippet

```xml
<organisations>

<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>
```

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

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

<OperatorRef version="1.0" id="noc:METR"/>
Tariff Zones know their stops

- All Zones can have a 2D spatial projection (i.e., polygon)
Membership of Tariff Zones by Stops is explicit.

- The model specifies which stops are in which tariff zone: a stop may be in more than one zone, zones may be 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)
TARIFF ZONEs can reference existing NaPTAN STOP POINTS

- NPTG already has PlusBus Zones with Polygons

```xml
<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">
    .......
  </FareZone>
</fareZones>
```
Nested Fare Zones - Metrorider & Metrovoyager

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

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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 accommodation
  - CLASS OF USE
  - ACCOMODATION
Tariff Structures & UK Bus Fares

- Tariff Structure
- Access Rights
## Basic UK Bus fare tariff types?

<table>
<thead>
<tr>
<th>Type of Product</th>
<th>TRIP (&quot;single ride&quot;)</th>
<th>PASS</th>
<th>Access rights</th>
<th>Tariff Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type of Product</td>
<td>PREASSIGNED FARE PRODUCT</td>
</tr>
<tr>
<td><strong>Short hop</strong></td>
<td></td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Single trip</strong></td>
<td></td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Time-limited (&quot;Hopper&quot;)</strong></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Period Return</strong></td>
<td></td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Day return</strong></td>
<td></td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Day pass</strong></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Termtime</strong></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Season pass</strong></td>
<td></td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
</tbody>
</table>

- **TRIP** ("single ride")
  - Short hop: TRIP, No break
  - Single trip: TRIP, Has use by date?
  - Time-limited ("Hopper"): TRIP, Max trip duration, Can interchange
  - Period Return: TRIP, Has use by date?
  - Day return: TRIP, Must use same day
  - Day pass: TRIP, 1D (elapsed or calendar)
  - Termtime: TRIP, Use during term 1Y
  - Season pass: TRIP, n x D,W,M, 1Y

- **PASS**
  - Day pass: PASS, 1D (elapsed or calendar)
  - Termtime: PASS, Use during term 1Y
  - Season pass: PASS, n x D,W,M, 1Y
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.
(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.
More complex UK Bus fare products - Carnets: Multi-trip / Multi-pass offers

<table>
<thead>
<tr>
<th>Access rights</th>
<th>Type of Product</th>
<th>FARE PRODUCT (AMOUNT OF PRICE UNIT)</th>
<th>Quantity</th>
<th>Related tariff structure</th>
<th>Temporal Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CARNET</td>
<td><strong>Multi-trip</strong></td>
<td>✔️</td>
<td>Any individual Trip</td>
<td>Trips have use-by date Trips can be time limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Multi-Day pass</strong></td>
<td>✔️</td>
<td>Day Pass</td>
<td>Passes have specified duration Passes have use-by date</td>
</tr>
</tbody>
</table>

**Tariff Structures**

- **CARNET**
  - **Multi-trip**
    - Quantity: ✔️
    - Related tariff structure: Any individual Trip
    - Temporal Conditions: Trips have use-by date, Trips can be time limited
  - **Multi-Day pass**
    - Quantity: ✔️
    - Related tariff structure: Day Pass
    - Temporal Conditions: Passes have specified duration, Passes have use-by date
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.
## Complex UK Bus Fare Products

Discount cards, etc

<table>
<thead>
<tr>
<th>Fare Product</th>
<th>Peak / Off Peak</th>
<th>(Can) or Must be Account Based</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Discount</td>
<td>✅</td>
<td>✅</td>
<td>E.g. like a Railcard</td>
</tr>
<tr>
<td>Capped Sales Discount</td>
<td>✅</td>
<td>✅</td>
<td>PAYG e.g. Oyster</td>
</tr>
<tr>
<td>Usage Discount</td>
<td>✅</td>
<td>✅</td>
<td>Rebate for use, e.g. mileage</td>
</tr>
<tr>
<td>Stored Value</td>
<td>-</td>
<td>✅</td>
<td>Stored value</td>
</tr>
<tr>
<td>Entitling Product</td>
<td>-</td>
<td>-</td>
<td>E.g. Military Pass</td>
</tr>
</tbody>
</table>
### Add-on UK Bus Fare Products Not needed except for Coach?

<table>
<thead>
<tr>
<th><strong>FARE PRODUCT</strong></th>
<th><strong>Tariff Structure</strong></th>
<th><strong>Notes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flat</strong></td>
<td><strong>Point to point</strong></td>
<td><strong>Named Zones</strong></td>
</tr>
<tr>
<td>Seat Reservation</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>Bicycle</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>Animal</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>Excess Luggage</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>Excursion</td>
<td>✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Special Event</td>
<td>✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓</td>
</tr>
</tbody>
</table>

**TRIP SUPPLEMENT**

**TRIP & PASS ADD ON**
Representing Tariff Spatial Structures in NeTEx
(with examples)

- Point-to-Point
- Zone
- Section Count
- Flat
- 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.
A Distance Matrix

1 Bewbush West - Crawley

Adult Single Fares

<table>
<thead>
<tr>
<th>Zone</th>
<th>Fare Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bewbush West</td>
<td>160</td>
</tr>
<tr>
<td>Gossops Green</td>
<td>160</td>
</tr>
<tr>
<td>Crawley</td>
<td>160</td>
</tr>
<tr>
<td>Southgate Avenue</td>
<td>160</td>
</tr>
<tr>
<td>Broadfield</td>
<td>160</td>
</tr>
<tr>
<td>Pease Pottage</td>
<td>160</td>
</tr>
</tbody>
</table>

**FARE PRICES**

**TARIFF**

**TARIFF ZONEs**
Moving Britain Ahead

Department for Transport

UK Bus Fare NeTex Profile

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
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.
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.
Zone topologies – Disjoint, nested, overlapping, doughnut etc...
Nested Fare Zones - Metrorider &

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

Class XSD NeTEx Lite - Validable Zones Places Intro

- **DataManagedObject**
  - **Tariff**
    - Defined by 0..*
    - Represented by 0..*
    - Used in 0..*

- **PriceableObject**
  - **ValidableElement**
    - Represented by 0..*
    - Specified by 0..*
    - Specifying limits for 0..*

- **Projection**
  - **TopographicalProjection**
    - Projecting 0..*
    - Located to 0..*
    - Located by 1
    - Including 0..1

- **Assignment**
  - **AccessRightParameterAssignment**
    - Including 0..1
    - Assigned to 0..*

- **Place**
  - **TopographicPlace**
    - Adjacent to 0..*
    - Adjacent from 0..*

Name: XSD NeTEx Lite - Validable Zones Places Intro
Author: Nick
Version: 1.0
Created: 01/11/2018 22:00:31
Updated: 01/11/2018 22:02:40
Named Zones - e.g. Plusbus

FARE ZONEs

TOPOGRAPHIC PLACEs

UK Bus Fare NeTex Profile
Named Zones in fare structure - XML Code Snippet

```xml
<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>
</Network>

<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>
    </GenericParameterAssignment>
  </validityParameterAssignments>
</FareStructureElement>
```

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

...
Stage / Section Count Tariff

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,

Uniform stage Size = approx Y km
Does not matter which section, just the number of sections.

<table>
<thead>
<tr>
<th>Section</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>£1.50</td>
</tr>
<tr>
<td>2</td>
<td>£1.50</td>
</tr>
<tr>
<td>3</td>
<td>£1.50</td>
</tr>
<tr>
<td>4</td>
<td>£2.50</td>
</tr>
<tr>
<td>5</td>
<td>£2.50</td>
</tr>
<tr>
<td>6</td>
<td>£2.50</td>
</tr>
<tr>
<td>7</td>
<td>£4.50</td>
</tr>
<tr>
<td>8</td>
<td>£4.50</td>
</tr>
<tr>
<td>9</td>
<td>£4.50</td>
</tr>
<tr>
<td>10</td>
<td>£5.50</td>
</tr>
<tr>
<td>X11</td>
<td>£5.50</td>
</tr>
<tr>
<td>X12</td>
<td>£5.50</td>
</tr>
</tbody>
</table>
### FARE PRICES

<table>
<thead>
<tr>
<th>Geographic Unit</th>
<th>Fares</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 - 03</td>
<td>£1.50</td>
</tr>
<tr>
<td>04 - 06</td>
<td>£2.50</td>
</tr>
<tr>
<td>07 - 09</td>
<td>£4.50</td>
</tr>
<tr>
<td>10+</td>
<td>£5.50</td>
</tr>
</tbody>
</table>

### FARE SECTIONS

<table>
<thead>
<tr>
<th>Geographic Interval</th>
<th>Fare Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 - 03</td>
<td>£1.50</td>
</tr>
<tr>
<td>04 - 06</td>
<td>£2.50</td>
</tr>
<tr>
<td>07 - 09</td>
<td>£4.50</td>
</tr>
<tr>
<td>10+</td>
<td>£5.50</td>
</tr>
</tbody>
</table>

### SCHEDULED STOP POINTS

- 1. Embersons Green, Sainsbury's
- 2. Blackberry Lane, Lower Lea
- 3. Long Close
- 4. New Station Road
- 5. Donnington
- 6. Narroways Road
- 7. Blackberry Hospital
- 8. St. Mary's Church
- 9. Blackberry Road

- Key:
  - Numbered sections
  - Busname stops - Section boundary stops
  - Cobalt Grey = All other bus stops

### 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 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:

- Embersons 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).
Dynamic zone counting: Trip planner uses JOURNEY PATTERN to determine number of FARE SECTIONs traversed between origin and destination POINT IN PATTERN.
Modelling Stage Fare Unit prices

GEOGRAPHIC UNIT = a Section

<table>
<thead>
<tr>
<th>id</th>
<th>Start</th>
<th>End</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>01</td>
<td>03</td>
<td>£1.50</td>
</tr>
<tr>
<td>002</td>
<td>04</td>
<td>06</td>
<td>£2.50</td>
</tr>
<tr>
<td>003</td>
<td>07</td>
<td>09</td>
<td>£4.50</td>
</tr>
<tr>
<td>004</td>
<td>10</td>
<td></td>
<td>£5.50</td>
</tr>
</tbody>
</table>

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

GEOGRAPHICAL INTERVAL PRICE
Representing the Available units – GEOGRAPHIC INTERVAL

<table>
<thead>
<tr>
<th>id</th>
<th>Start</th>
<th>End</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>01</td>
<td>03</td>
<td>£1.50</td>
</tr>
</tbody>
</table>
Stage Fares – Modelling
Stage definitions
Flat tariff – not progressive spatially

**UK Bus Fare**

**NeTex**

<table>
<thead>
<tr>
<th>Cost</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>STOP</td>
</tr>
<tr>
<td>B</td>
<td>STOP</td>
</tr>
<tr>
<td>D</td>
<td>STOP</td>
</tr>
<tr>
<td>E</td>
<td>STOP</td>
</tr>
<tr>
<td>F</td>
<td>STOP</td>
</tr>
<tr>
<td>G</td>
<td>STOP</td>
</tr>
<tr>
<td>H</td>
<td>STOP</td>
</tr>
<tr>
<td>I</td>
<td>STOP</td>
</tr>
<tr>
<td>J</td>
<td>STOP</td>
</tr>
<tr>
<td>K</td>
<td>STOP</td>
</tr>
<tr>
<td>L</td>
<td>STOP</td>
</tr>
<tr>
<td>M</td>
<td>STOP</td>
</tr>
</tbody>
</table>
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 have other price dimensions
  - E.g. separate adult & child fare prices
Flat Rate tariff Example

- Railcard priced by user type.
Representing Tariff Temporal Structures & Products in NeTEx
(with examples)

- Time Intervals
- Validity Periods
- Fare Demand Periods
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

```
Space

Destination

Origin

Time

start trip

end trip

start return trip

end return trip
```

UK Bus Fare NeTex Profile
We can visualise trips as lines in space time, made within the boundaries of a product validity.
- E.g. two separate tickets.
We can visualise passes as bands in space time within which frequent or unlimited trips can be made.
1. Time intervals
Season Pass with choice of durations – TIME INTERVALS

Crawley Metrorider
Unlimited travel in the Crawley Metrorider area.

- Adult
- Child
- Student
- Family

<table>
<thead>
<tr>
<th></th>
<th>1 day</th>
<th>1 week</th>
<th>Even**g</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price</strong></td>
<td>£4.90</td>
<td>£20</td>
<td>£4</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>£1.10</td>
<td>£4.45</td>
<td>£9.75</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>£2.20</td>
<td>£4.20</td>
<td>£7.90</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>£3.70</td>
<td>£5.90</td>
<td>£13.50</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>£7.90</td>
<td>£10</td>
<td>£18</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>£59</td>
<td>£80</td>
<td>£135.50</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>£325.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* All day travel for up to 5 people (minimum of 1 adult & maximum of 2 adults travelling at any one time).
** Available from 1800 and valid until 0519 on the following day.
*** For 2 adults, travelling together.

FARE ZONE
FARE PRICES
SALES PACKAGES
TYPE OF TRAVEL DOCUMENTS

Moving Britain Ahead
Season Pass with choice of durations – TIME INTERVALS

TIME INTERVALS

<table>
<thead>
<tr>
<th></th>
<th>60 minute</th>
<th>1 day</th>
<th>2 day#</th>
<th>3 day#</th>
<th>1 week</th>
<th>4 week</th>
<th>Duo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>£2.20</td>
<td>£4.20</td>
<td>£7.90</td>
<td>£11.50</td>
<td>£18</td>
<td>£59</td>
<td>£7.90</td>
</tr>
<tr>
<td>Price</td>
<td>£1.10</td>
<td>£2.35</td>
<td>£4.45</td>
<td>£6.45</td>
<td>£9.75</td>
<td>£32.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>£60</td>
</tr>
</tbody>
</table>
2. Use-by dates (And other commercial conditions)
Trips – Basic time concepts

Must buy ticket within this period before (or maybe even during) travel

PURCHASE WINDOW

“Use-by” date

USAGE VALIDITY PERIOD

To start by

TO COMPLETE BY

USAGE VALIDITY PERIOD

Fixed Start time

Flexible Start time

Maximum permitted Travel duration

TIME INTERVAL

start trip

end trip

To complete by

“Use-by” date

USAGE VALIDITY PERIOD

To start by

PURCHASE WINDOW

Must buy ticket within this period before (or maybe even during) travel

PURCHASE WINDOW

“Use-by” date

USAGE VALIDITY PERIOD

To start by
Single Trip – More TIME concepts

**Maximum permitted Travel duration**

**TIME INTERVAL**

**INTERCHANGING**
- No interchanging
- No journey break

**INTERCHANGING**
- Can interchange
- Can break journey

**INTERCHANGING**
- Can Interchange
- Can break journey

**USAGE VALIDITY PERIOD**

**To start by**

**To complete by**
Products – Time concepts relating to commercial conditions

- Can have separate conditions to a FARE PRODUCT, and a whole SALE OFFER PACKAGE comprising several products.
Assigning 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
3. Peak/Offpeak Fare Demand periods
Peak / Off-peak Fares & Blackouts

VALIDITY CONDITIONS

FARE DEMAND FACTORS
Peak, off-peak, weekend, etc.

DAY TYPE
TIMEBAND

TIME

STOP

SPACE
Peak and Offpeak – Fares

- E.g. Concessionary Pass product 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.
For example

Monday to Friday

Saturday
Associating access rights with Products and Sales Offers
Instances for a typical Fare Product & Sales Offer
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 validated 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
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

Conditions may be stated:
(a) on consumption of access rights (VALIDABLE ELEMENT, FARE STRUCTURE ELEMENT, FARE STRUCTURE ELEMENT IN SEQUENCE)
(b) on sale of product (FARE PRODUCT, SALES OFFER PACKAGE)
Instances for a typical Fare Product & Sales Offer

TARIFF
FARE STRUCTURE ELEMENTs
PARAMETER ASSIGNMENTs (fare structure)
DISTANCE MATRIX ELEMENTs
TIME INTERVALs
VALIDABLE ELEMENTs (product)
PARAMETER ASSIGNMENTs (validable element)
PARAMETER ASSIGNMENTs (fare structure)
PARAMETER ASSIGNMENTs (validable element)
PARAMETER ASSIGNMENTs (product)
PARAMETER ASSIGNMENTs (sales offer element)
PARAMETER ASSIGNMENTs (sales offer)
SALES OFFER PACKAGE ELEMENTs
SALES OFFER PACKAGE
Scoping & Temporal Parameters
TARIFF ZONEs
OPERATORS
USER PROFILEs
DAY TYPES
MODEs
Etcetera
A Zone to Zone Product: Use DISTANCE MATRIX + Assign OPERATOR, MODE, USER PROFILES, etc.
A POINT TO POINT FARE PRODUC
A Season Pass Product: Assign FARE ZONEs + OPERATOR, MODE, & USER PROFILEs

- **Crawley Metrorider**
  - Unlimited travel in the Crawley Metrorider area.
  - 1 day: £4.00, £3.10, £4
  - 1 week: £20

- **Horsham Metrorider**
  - Unlimited travel in the Horsham Metrorider area.
  - 1 day: £3.00, £1.11
  - 1 week: £20

- **Redhill & Reigate Metrorider**
  - Unlimited travel in the Redhill & Reigate Metrorider area.
  - 1 day: £4.60, £20
  - 1 week: £2.70, £14

- **Metrovoyager**
  - This ticket bought on the bus gives you unlimited travel on all of our services across our entire network, including both the Crawley, Horsham, and Redhill & Reigate Metrorider areas.
  - 1 day: £4.00, £3.10
  - 1 week: £20

**UK Bus Fare NeTex Profile**
What product options and features need to be included / excluded?

- User Profiles
- Group Tickets
- Travel Conditions
- Luggage
- Sales and after sales
- Product Entitlements
Instances for a typical Fare Product & Sales Offer

- **TARIFF**
- **FARE STRUCTURE ELEMENTs**
- **DISTANCE MATRIX ELEMENTs**
- **TIME INTERVALs**
- **VALIDABLE ELEMENTs (product)**
- **FARE PRODUCTS**
- **PARAMETER ASSIGNMENTs (product)**
- **SALES OFFER PACKAGE**
- **SALES OFFER PACKAGE ELEMENTs**
- Scoping & Temporal Parameters

- **TARIFF ZONEs**
- **OPERATORS**
- **USER PROFILEs**
- **DAY TYPEs**
- **MODEs**
- **Etcetera**
#6.1: UK Bus Fares - User Types?

<table>
<thead>
<tr>
<th>USER PROFILE</th>
<th>Personal</th>
<th>Discounted</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>x</td>
<td>x</td>
<td>Over 16</td>
</tr>
<tr>
<td>Infant</td>
<td>x</td>
<td>✓</td>
<td>Babes in arms free</td>
</tr>
<tr>
<td>Child</td>
<td>x</td>
<td>✓</td>
<td>c5 – c16 years</td>
</tr>
<tr>
<td>Youth</td>
<td>x</td>
<td>✓</td>
<td>c16-18 years</td>
</tr>
<tr>
<td>School Pupil</td>
<td>x</td>
<td>✓</td>
<td>At School</td>
</tr>
<tr>
<td>Student / Trainee</td>
<td>✓</td>
<td>✓</td>
<td>University, Apprentice</td>
</tr>
<tr>
<td>Senior</td>
<td>✓</td>
<td>✓</td>
<td>Resident, &gt;60 years</td>
</tr>
<tr>
<td>Disabled</td>
<td>✓</td>
<td>✓</td>
<td>Registered disabled</td>
</tr>
<tr>
<td>Disabled Companion</td>
<td>✓</td>
<td>✓</td>
<td>With disabled</td>
</tr>
<tr>
<td>Job seeker</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
#6.2: UK Bus Fares – Corporate User Types?

<table>
<thead>
<tr>
<th>CORPORATE PROFILE</th>
<th>Personal</th>
<th>Discounted</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armed Forces</td>
<td>✓</td>
<td>✓</td>
<td>Registered</td>
</tr>
<tr>
<td>Employee Scheme</td>
<td>✓</td>
<td>✓</td>
<td>E.g. Gatwick Airport Staff</td>
</tr>
</tbody>
</table>

**CORPORATE PROFILE**

- **Personal**
- **Discounted**
- **Note**

**Note**

- Registered
- E.g. Gatwick Airport Staff
#6.3: UK Bus Profile – Group Ticket Types?

<table>
<thead>
<tr>
<th>GROUP TICKET</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anyone</td>
<td>2-N Anyone</td>
</tr>
<tr>
<td>Family</td>
<td>1-2 Adults + 1-N, Children</td>
</tr>
<tr>
<td>Couple / Duo</td>
<td>2 Adults</td>
</tr>
<tr>
<td>School Pupils</td>
<td>1-N Adults + 2-N Pupils</td>
</tr>
</tbody>
</table>
# UK BUS Product parameters – Travel Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Condition</th>
<th>Local Trip</th>
<th>Coach Trip</th>
<th>Season Ticket</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAVEL HOW</td>
<td>Right to Interchange</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>Trips only</td>
</tr>
<tr>
<td>TRAVEL HOW</td>
<td>Right to Break Journey</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>Trips only</td>
</tr>
<tr>
<td>TRAVEL HOW</td>
<td>Routing Restrictions</td>
<td>X</td>
<td>?</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>TRAVEL WHEN</td>
<td>Round Trip</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>Single, Period Return, Day Trip</td>
</tr>
<tr>
<td>TRAVEL WHEN</td>
<td>Usage Validity Period</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>See discussion of temporal factors</td>
</tr>
<tr>
<td>TRAVEL WHEN</td>
<td>Frequency of Use</td>
<td>X</td>
<td>X</td>
<td>✓</td>
<td>e.g. 2 per day, vs unlimited use</td>
</tr>
<tr>
<td>TRAVEL WHEN</td>
<td>Minimum Stay</td>
<td>X</td>
<td>?</td>
<td>X</td>
<td>Excursion products only?</td>
</tr>
</tbody>
</table>
For bus, Passenger information only? No pricing implications

<table>
<thead>
<tr>
<th>Condition</th>
<th>LUGgage ALLOWANCE</th>
<th>Relevance</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Local Trip</td>
<td>Coach Trip</td>
<td>Season Ticket</td>
</tr>
<tr>
<td>Suitc</td>
<td>Pram</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Wheelchair</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Suitcase</td>
<td>Suitcase</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Animal</td>
<td>Guide dog</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Pet</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
# UK BUS Product Parameters – Sales & After-Sales Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Condition</th>
<th>Local Trip</th>
<th>Coach Trip</th>
<th>Season Ticket</th>
<th>Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Presales</strong></td>
<td>Period in which a ticket can be bought.</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td><strong>PURCHASE WINDOW</strong></td>
</tr>
<tr>
<td></td>
<td>Period and conditions for reserving a ticket.</td>
<td>x</td>
<td>✓</td>
<td>✗</td>
<td><strong>RESERVING</strong></td>
</tr>
<tr>
<td></td>
<td>Can ticket be given to another to use?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td><strong>TRANSFERABILITY</strong></td>
</tr>
<tr>
<td></td>
<td>Can reservation be cancelled?</td>
<td>x</td>
<td>✓</td>
<td>✗</td>
<td><strong>CANCELLING</strong></td>
</tr>
<tr>
<td></td>
<td>Can you modify travel times or change journey details?</td>
<td>x</td>
<td>✓</td>
<td>✗</td>
<td><strong>EXCHANGING</strong></td>
</tr>
<tr>
<td><strong>After Sales</strong></td>
<td>Can you get all or some money back?</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td><strong>REFUNDING</strong></td>
</tr>
<tr>
<td></td>
<td>Can you get a replacement for a lost ticket?</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
<td><strong>REPLACING</strong></td>
</tr>
</tbody>
</table>
For bus, Passenger information only? No pricing implications

<table>
<thead>
<tr>
<th>Condition</th>
<th>Local Trip</th>
<th>Coach Trip</th>
<th>Season Ticket</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pram</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
<td>Trips only</td>
</tr>
<tr>
<td>Wheelchair</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
<td>Trips only</td>
</tr>
<tr>
<td>Suitcase</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
<td>Trips only. Might be chargeable for coach</td>
</tr>
<tr>
<td>Guide dog</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>See discussion of temporal factors</td>
</tr>
<tr>
<td>Pet</td>
<td>x</td>
<td>x</td>
<td>✓</td>
<td>e.g. 2 per day, vs unlimited use</td>
</tr>
</tbody>
</table>
Prerequisites & Dependencies between products

- How may products and sales offers depend on each other

<table>
<thead>
<tr>
<th>Condition</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entitlement Required</td>
<td>Specifies a prerequisite product</td>
</tr>
<tr>
<td>Entitlement Given</td>
<td>Specifies rights to another products</td>
</tr>
</tbody>
</table>
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
Representing product options and features in NeTEx

- User Types
- Group Tickets
**USER PROFILEs**
- Adult, Child, Student

**GROUP TICKET**
(Family)

---

Crawley Metrorider

- Unlimited travel in the Crawley Metrorider area.
- *All day* to *up to 5 people* (minimum of 1 adult & maximum of 2 adults traveling at any one time).
- **Available from 31/10 and valid until 03/09**.
- **For 2 adults, traveling together.**

<table>
<thead>
<tr>
<th></th>
<th>Cash</th>
<th>m-tickets</th>
<th>the key</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 day</td>
<td>1 week</td>
<td>1 week</td>
</tr>
<tr>
<td>Adult</td>
<td>£4.90</td>
<td>£20</td>
<td>£20</td>
</tr>
<tr>
<td>Child</td>
<td>£2.70</td>
<td>£11</td>
<td>£11.50</td>
</tr>
<tr>
<td>Student</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family*</td>
<td>£9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

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UK Bus Fare NeTex Profile
User types in NeTEx implemented as USER PROFILES

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

- Easy to extend with new attributes or parameters
What Sales Offer and distribution features need to be included / excluded?

- Types of Travel Documents
- Distribution Channels
- Payment Methods
Instances for a typical Fare Product & Sales Offer

- TARIFF
- FARE STRUCTURE ELEMENTs
- DISTANCE MATRIX ELEMENTs
- TIME INTERVALs

VALIDABLE ELEMENTs (product)
- FARE PRODUCTs

SALES OFFER PACKAGE ELEMENTs

Scoping & Temporal Parameters
- TARIFF ZONEs
- OPERATORS
- USER PROFILEs
- DAY TYPES
- MODEs
- Etcetera

PARAMETER ASSIGNMENTs (sales offer)
#7.1: UK Bus – Media / Travel Documents?

<table>
<thead>
<tr>
<th>TYPE OF TRAVEL DOCUMENT</th>
<th>Machine Readable</th>
<th>Human Readable</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>Barcode, OCR, ShotCode, etc</td>
<td>✓</td>
<td>From machine or conductor</td>
</tr>
<tr>
<td>E-document/pdf</td>
<td>Barcode, OCR, ShotCode, etc</td>
<td>✓</td>
<td>Self print / store on mobile device</td>
</tr>
<tr>
<td>SMS /MMS</td>
<td>Barcode, OCR, ShotCode, etc</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Card</td>
<td>OCR</td>
<td>✓</td>
<td>e.g. Travel card</td>
</tr>
<tr>
<td>Magstripe</td>
<td>Contact</td>
<td>✓</td>
<td>Ticket Machine / Counter only</td>
</tr>
<tr>
<td>EMV</td>
<td>Contact, NFC</td>
<td>x</td>
<td>Account Based Ticketing has id but no app</td>
</tr>
<tr>
<td>SmartCard</td>
<td>Contact, NFC</td>
<td>x</td>
<td>(ABT) Has travel app chip</td>
</tr>
<tr>
<td>Mobile App</td>
<td>NFC, (bluetooth)</td>
<td>✓</td>
<td>ABT Downloadable to smart device</td>
</tr>
</tbody>
</table>
#7.2: UK Bus – Distribution Channels?

<table>
<thead>
<tr>
<th>DISTRIBUTION CHANNEL</th>
<th>Fulfilment</th>
<th>Payment</th>
<th>Charging Moment</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staffed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticket Office Counter</td>
<td>Immediate (or despatch)</td>
<td>Cash, Card, ePay</td>
<td>Prepaid</td>
<td>All</td>
</tr>
<tr>
<td>On board / Conductor</td>
<td>Immediate</td>
<td>Cash, Card, ePay</td>
<td>Prepaid</td>
<td>Trips, day passes</td>
</tr>
<tr>
<td>Retailer</td>
<td>Despatch</td>
<td>Card, ePay, (bank)</td>
<td>Prepaid</td>
<td></td>
</tr>
<tr>
<td>Call Centre</td>
<td>Despatch</td>
<td>Card, ePay, (bank)</td>
<td>Prepaid</td>
<td>Travel cards, season passes</td>
</tr>
<tr>
<td><strong>Self Service</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticket Machine</td>
<td>Immediate</td>
<td>Cash, Card, (ePay)</td>
<td>Prepaid</td>
<td>At Stop / Also On board</td>
</tr>
<tr>
<td>Online, mobile</td>
<td>Immediate or despatch</td>
<td>Card, ePay</td>
<td>Prepaid</td>
<td>Anywhere</td>
</tr>
<tr>
<td>Electronic</td>
<td>Immediate (or on travel)</td>
<td>Card, ePay</td>
<td>Pre &amp; Post Pay (Pay as you go)</td>
<td>Acquire, top up / purchase etc</td>
</tr>
</tbody>
</table>
#7.3: UK Bus – Payment Methods?

<table>
<thead>
<tr>
<th>PAYMENT METHOD</th>
<th>Subscription/ Top up</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANONYMOUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>x</td>
<td>£</td>
</tr>
<tr>
<td>Cash – Coins only</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>ELECTRONIC/MOBILE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMV Card</td>
<td>✓</td>
<td>Self print / store on mobile device</td>
</tr>
<tr>
<td>ePay</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SMS</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>OTHER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank transfer</td>
<td>✓</td>
<td>Use for Season Passes, Auto top up, &amp; Subscriptions</td>
</tr>
<tr>
<td>Cheque</td>
<td>x</td>
<td>Eg. For Season Passes</td>
</tr>
<tr>
<td>Coupon/Voucher</td>
<td>x</td>
<td>E.g. for promotions</td>
</tr>
</tbody>
</table>
### Bus – Offer: Fulfilment Methods

<table>
<thead>
<tr>
<th>Type of method</th>
<th>FULFILMENT METHOD</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLLECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collect from driver or conductor</td>
<td>Collect at counter</td>
<td>Basic products</td>
</tr>
<tr>
<td></td>
<td>COLLECT</td>
<td></td>
</tr>
<tr>
<td>Collect at Machine</td>
<td>Collect at Machine</td>
<td>E.g. for Season passes, Not all products</td>
</tr>
<tr>
<td></td>
<td>COLLECT</td>
<td></td>
</tr>
<tr>
<td>Collect at shop</td>
<td>Collect at shop</td>
<td>Basic products</td>
</tr>
<tr>
<td></td>
<td>REMOTE DOWNLOAD</td>
<td></td>
</tr>
<tr>
<td>Download to device</td>
<td>Download to device</td>
<td>App or pdf eticket</td>
</tr>
<tr>
<td></td>
<td>REMOTE DOWNLOAD</td>
<td></td>
</tr>
<tr>
<td>Self print</td>
<td>Self print</td>
<td>Self print to paper</td>
</tr>
<tr>
<td></td>
<td>REMOTE DOWNLOAD</td>
<td></td>
</tr>
<tr>
<td>email</td>
<td>email</td>
<td>Online &amp; call centre purchases</td>
</tr>
<tr>
<td></td>
<td>REMOTE DOWNLOAD</td>
<td></td>
</tr>
<tr>
<td>SMS</td>
<td>SMS</td>
<td>Online purchases</td>
</tr>
<tr>
<td></td>
<td>DESPATCH</td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>Post</td>
<td>E.g. For Season Passes</td>
</tr>
<tr>
<td></td>
<td>DESPATCH</td>
<td></td>
</tr>
<tr>
<td>Courier</td>
<td>Courier</td>
<td>E.g. Online - Extra fee</td>
</tr>
</tbody>
</table>
### Adding Distribution Parameters

#### Payment Method

- Class: XD NetEx Lite - Sales Package Overview
- **Name:** XD NetEx Lite - Sales Package Overview
- **Author:** Nick
- **Version:** 1.0
- **Created:** 25/11/2011 00:00:00
- **Updated:** 31/10/2018 19:59:20

#### Distribution Channel

- **Type Of Travel Document**
- **Payment Method**
- **Type Of Entity**
- **Fulfillment Method**
- **Fulfillment Method Price**

#### Travel Document Types

- **Crawley Metrorider**
  - Unlimited travel in the Crawley Metrorider area.
  - **1 day:** £4.90, £20, £4
  - **1 week:** £7.80, £11.50, £18
  - **2 days:** £7.80, £11.50, £18
  - **3 days:** £7.80, £11.50, £18
  - **4 weeks:** £7.80, £11.50, £18
  - **Annual:** £6.20, £18, £59, £154, £520, £13.70

- **Bought on bus with cash**
- **Stored on your mobile phone as m-tickets**
- **Loaded onto our smartcard the key**
Representing sales and distribution options in NeTEx

- User Types
- Group Tickets
Further Aspects of Modelling Fares

Prices
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
Prices are separate from the things they price
  - This allows them to be changed and exchanged separately
  - 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. ROUNDELING RULES
  - When a price is derived, the calculation steps may be recorded
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
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
Price Rules – Specify discounts etc
Nesting Tables

- Tables can be nested
  - Efficient encoding in XML – Avoids repetition of common properties
Different PRICEABLE OBJECTs can be associated with Table, Row, Column and Cell

- Cell references the price for the combination
Metrobus 1 - Dissected
Each cell can refer to a price

<table>
<thead>
<tr>
<th>Prices - Allowed combinations</th>
</tr>
</thead>
</table>

FARE STRUCTURE ELEMENT / TARIFF ZONE

TIME INTERVAL

USER PROFILE
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

Nestable Fare Tables – Formatting

Col1  Col2  Col3  ...  ColM

Row1  Cell 1,1  Cell 1,2  ...  Cell 1,m

Row2

Row3

...  ...  ...

RowN  Cell n,1

Notice1
UK Profile General Issues

Use existing where available

Allow for distributed allocation of ids by Operator.
#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
Building on Existing data elements

- **FARE FRAME** (Products & Tariffs)
- **SERVICE CALENDAR FRAME** (Day Types, etc)
- **SERVICE FRAMEs** (Stops & lines etc)
- **SITE FRAME** (Physical Stops, Accessibility, etc)
- **SERVICE FRAMEs**
- **COMPOSITE FRAME** Grouping
- **RESOURCE FRAMEs**
- **TIMETABLE FRAMEs** (Products & Tariffs)
- **SALES TRANSACTION FRAMEs** (Purchases)
Organising Tariffs, Products and Prices with Frames

- **Metrobus Trip Tickets**
- **Metrobus Season Tickets**
- **Common Metrobus**
- **Common UK**

**FARE FRAME**: (Prices)

**FARE FRAME**: (Products & Tariffs)

**SERVICE FRAME**: (Stops & lines etc)

**RESOURCE FRAME**: (UK common codes)

**RESOURCE FRAME**: (MB common codes)
Modularise; references may be internal or external

NeTex XML documents
#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?
#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
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

- **Organisations**
  - Operator (RU)
  - Country

- **Units**
  - Kilometers, Currency

- **Value Sets** (Use to establish common EU values)
  - Train categories
  - Seat Classes (first, second, etc)
Summary?
Describing Fares with NeTEx
## Basic UK Bus fare tariff types?

<table>
<thead>
<tr>
<th>Access rights</th>
<th>Tariff Structure</th>
<th>Temporal Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Product</td>
<td>PREASSIGNED FARE PRODUCT</td>
<td></td>
</tr>
<tr>
<td>TRIP (&quot;single ride&quot;)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flat</strong></td>
<td><strong>Point to point</strong></td>
<td><strong>Named Zones</strong></td>
</tr>
<tr>
<td>Short hop</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Single trip</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Time-limited (&quot;Hopper&quot;)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Period Return</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Day return</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>PASS</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Day pass</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Termtime</td>
<td>-</td>
<td>?</td>
</tr>
<tr>
<td>Season pass</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Instances for a typical Fare Product & Sales Offer

1. **TARIFF**
   - FARE STRUCTURE ELEMENTs
   - VALIDABLE ELEMENTs (product)
   - FARE PRODUCTS
   - SALES OFFER PACKAGE ELEMENTs

2. **FARE STRUCTURE ELEMENTs**
   - PARAMETER ASSIGNMENTs (fare structure)
   - PARAMETER ASSIGNMENTs (validable element)
   - PARAMETER ASSIGNMENTs (product)
   - PARAMETER ASSIGNMENTs (sales offer element)

3. **DISTANCE MATRIX ELEMENTs**
   - Scoping & Temporal Parameters
   - PARAMETER ASSIGNMENTs (sales offer)

4. **TIME INTERVALs**
   - TARIFF ZONEs
   - OPERATORS
   - USER PROFILEs
   - DAY TYPES
   - MODEs
   - Etcetera
A Zone to Zone Product: Use DISTANCE MATRIX + Assign OPERATOR, MODE, USER PROFILES, etc
A Season Pass Product: Assign FARE ZONEs + OPERATOR, MODE, & USER PROFILEs

162 UK Bus Fare NeTex Profile
Modelling – Stage definitions

- Dynamic zone counting: Trip planner uses JOURNEY PATTERN to determine number of FARE SECTIONs traversed between origin and destination POINT IN PATTERN
Easy to extend with new attributes or parameters
Benefits of Transmodel / Netex Approach

- **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
Some Drawbacks

- Initial 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