NeTEx Technical Workshop – Routes & Timetables
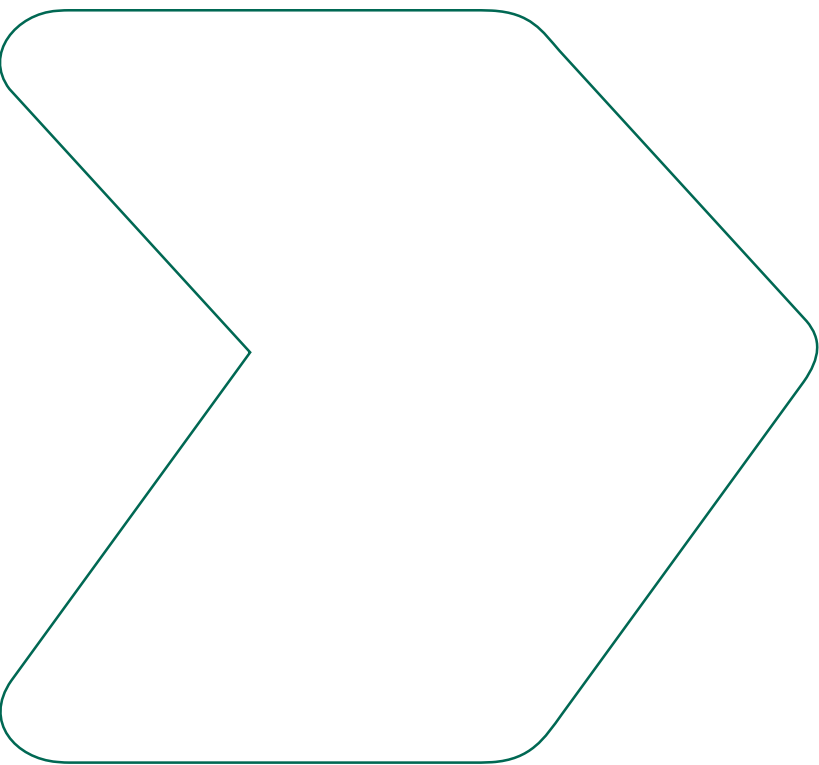
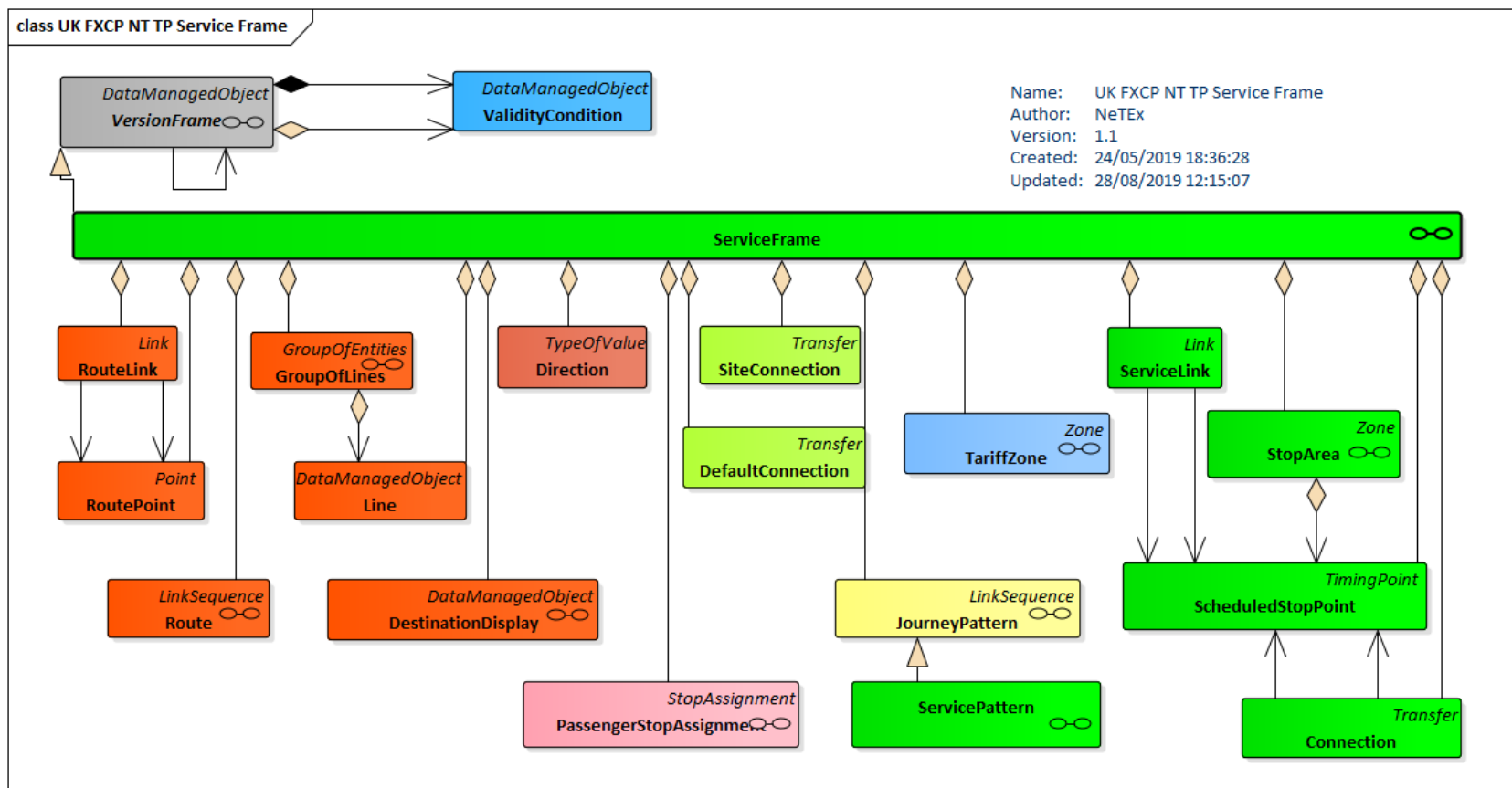## London

August 2019   Stuart Reynolds

Using NeTEx for Routes and Timetables

1. Overview
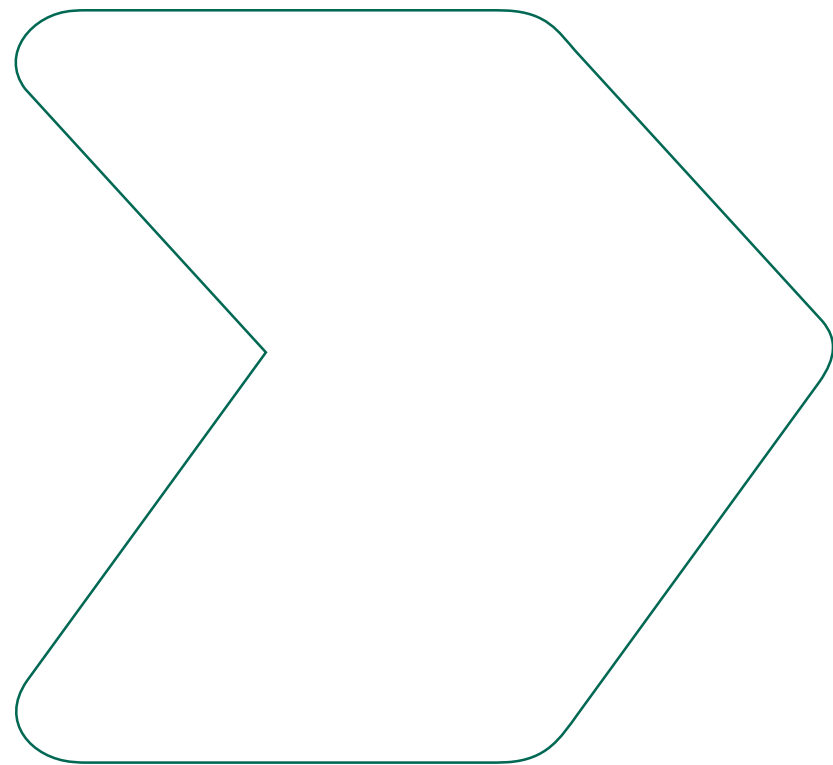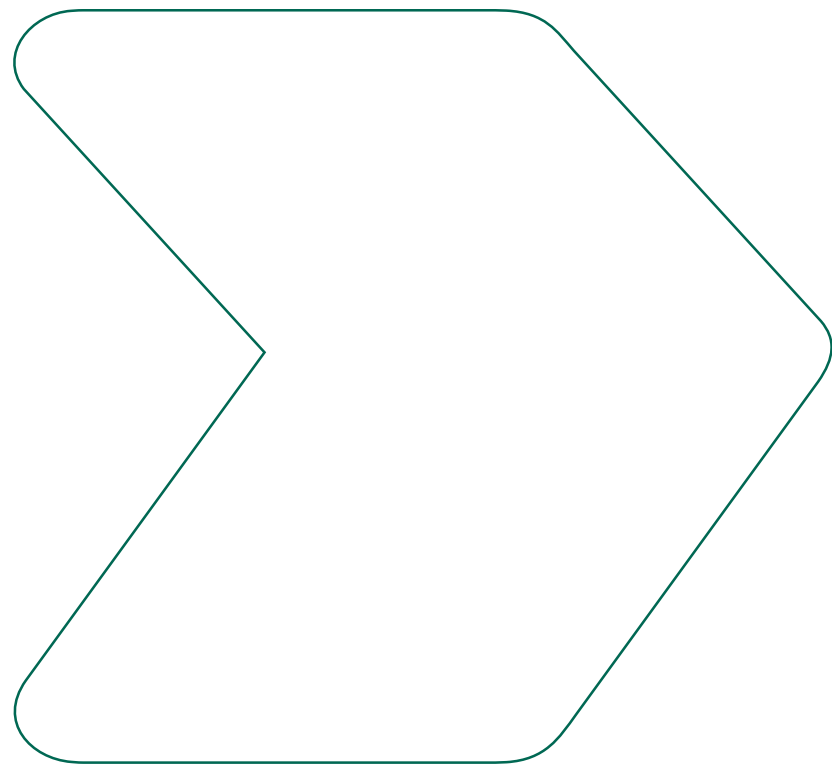
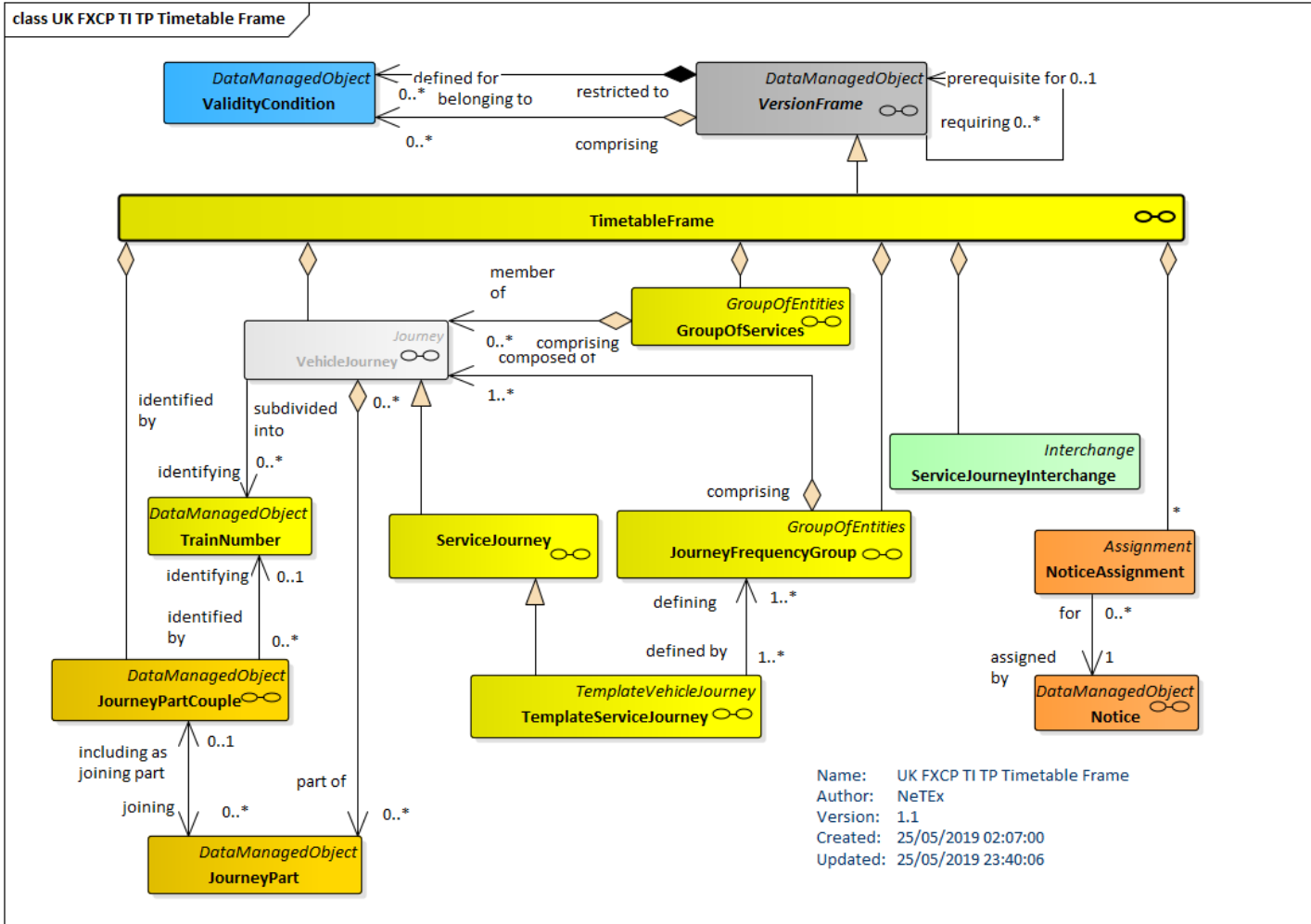- A SERVICE FRAME holds all of the information about the service
  - Physical ROUTE and ROUTE LINKs
  - JOURNEY PATTERNs

- A TIMETABLE FRAME holds all of the information relating to the timetable i.e. the published journeys and times that a passenger can use for travelling
  - SERVICE JOURNEYs (equivalent to TXC *VehicleJourney*) with TIMETABLED PASSING TIMES at each stop where passengers can board or alight
  - Frequent services using JOURNEY FREQUENCY GROUP
  - Interchanges between journeys using SERVICE JOURNEY INTERCHANGE
  - Coupled journeys using JOURNEY PART / JOURNEY PART COUPLE
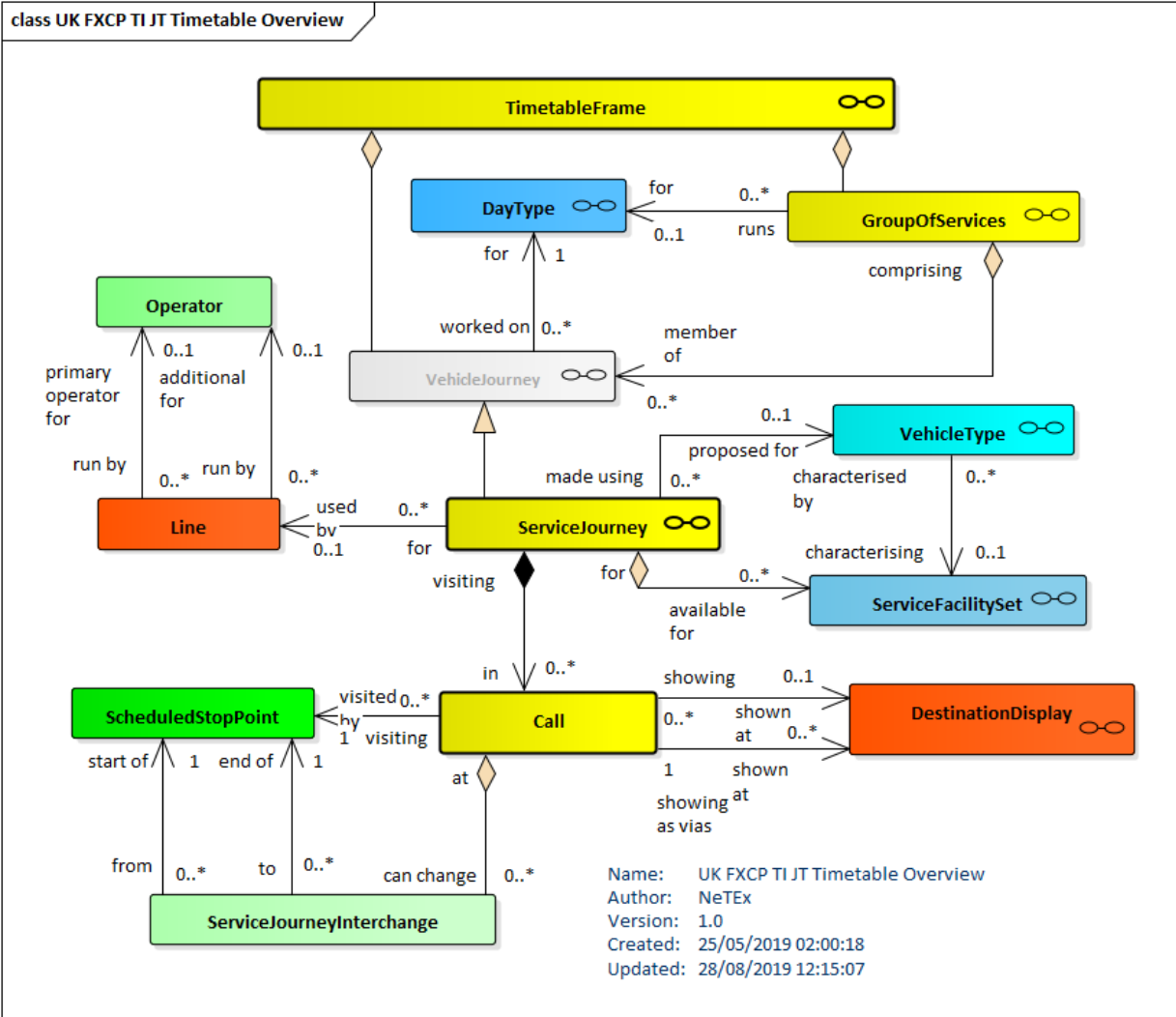
- Timetable comprises a number of SERVICE JOURNEY elements
- SERVICE JOURNEYs are:
  - allocated to a LINE
  - operated by an OPERATOR (via the LINE)
  - assigned to a particular VEHICLE TYPE
  - operated on a particular DAY TYPE
- A SERVICE JOURNEY has an ordered set of SCHEDULED STOP POINTs, to which times are added
- In FXCP, SERVICE JOURNEY is mandated to additionally include a set of CALL elements describing the link, the activity, and other related information

Using NeTEx for Routes and Timetables

2. Detail and Examples

Department for Transport
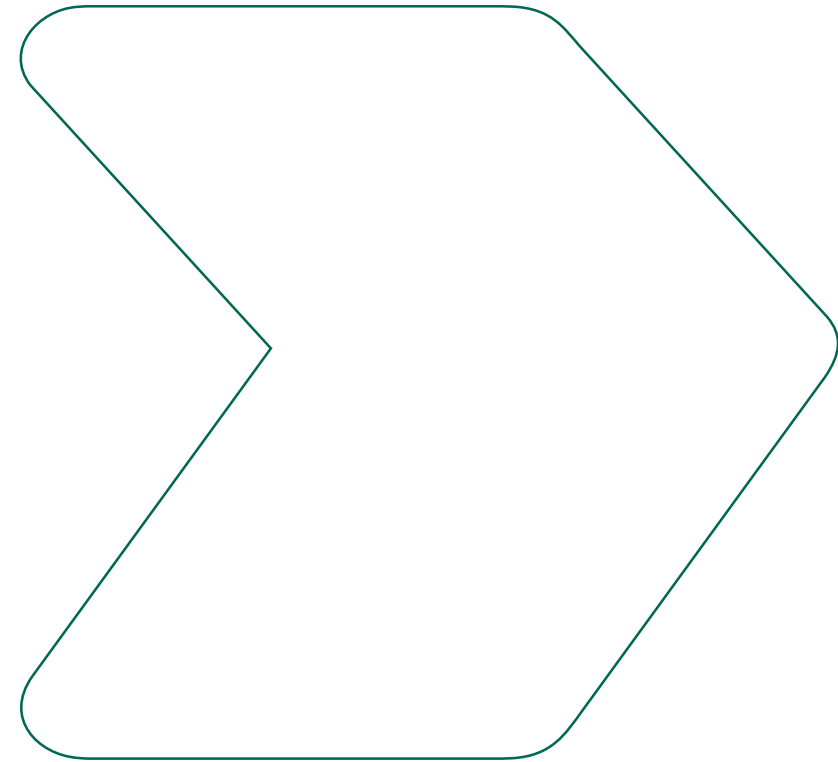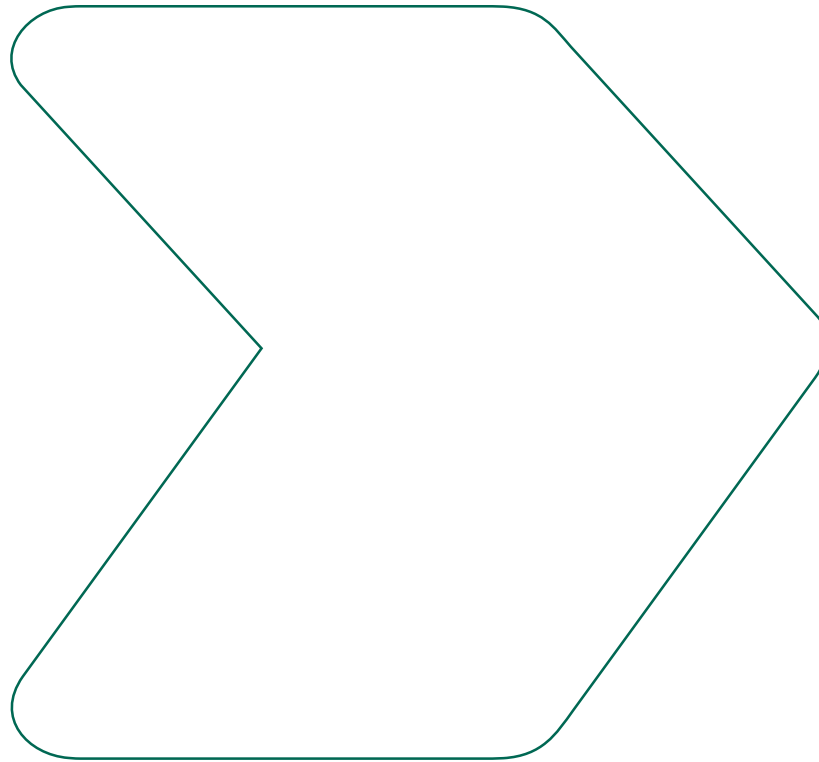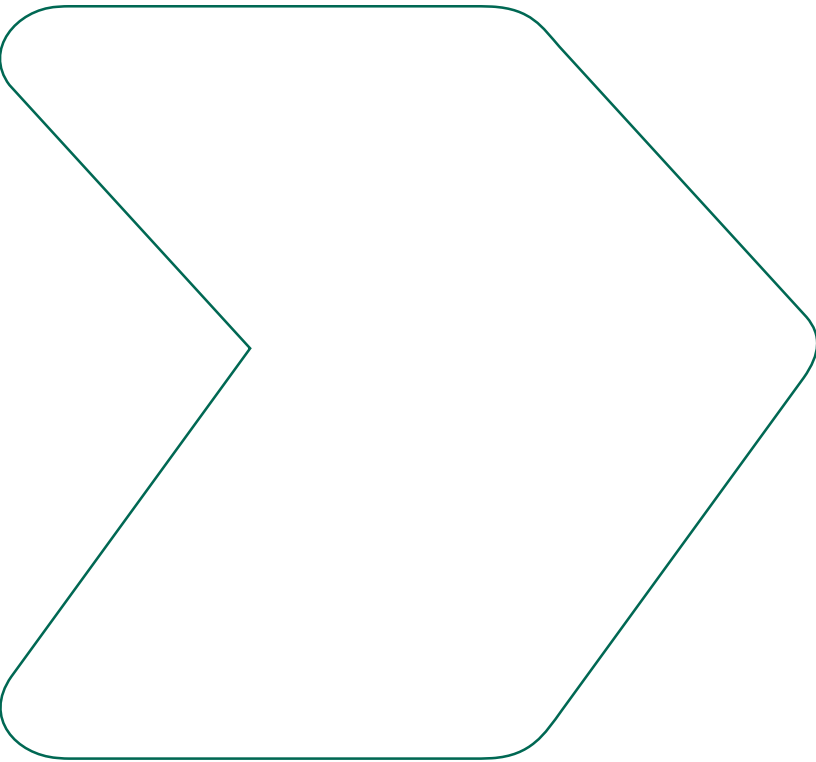
- Similar to XML *Namespace*
- Ensures identifiers are unique, even if from different systems and in same document
- Allows applications to access schema / rules for external elements ⇒ assists validation

- In FXCP, codespaces are used for:
  - o Locality identifiers for NPTG
  - o Stop identifiers for NaPTAN
  - o Operator identifiers for NOC
  - o Identifiers from operators' own datasets
- FXCP pre-defines a number of codespaces and prefixes

- Every change to every element in NeTEx can be tracked ⇒ too much for many systems, though
- Full tracking is optional in FXCP
- Frame level versioning is mandatory in FXCP

- Can be used to specify the validity of an object
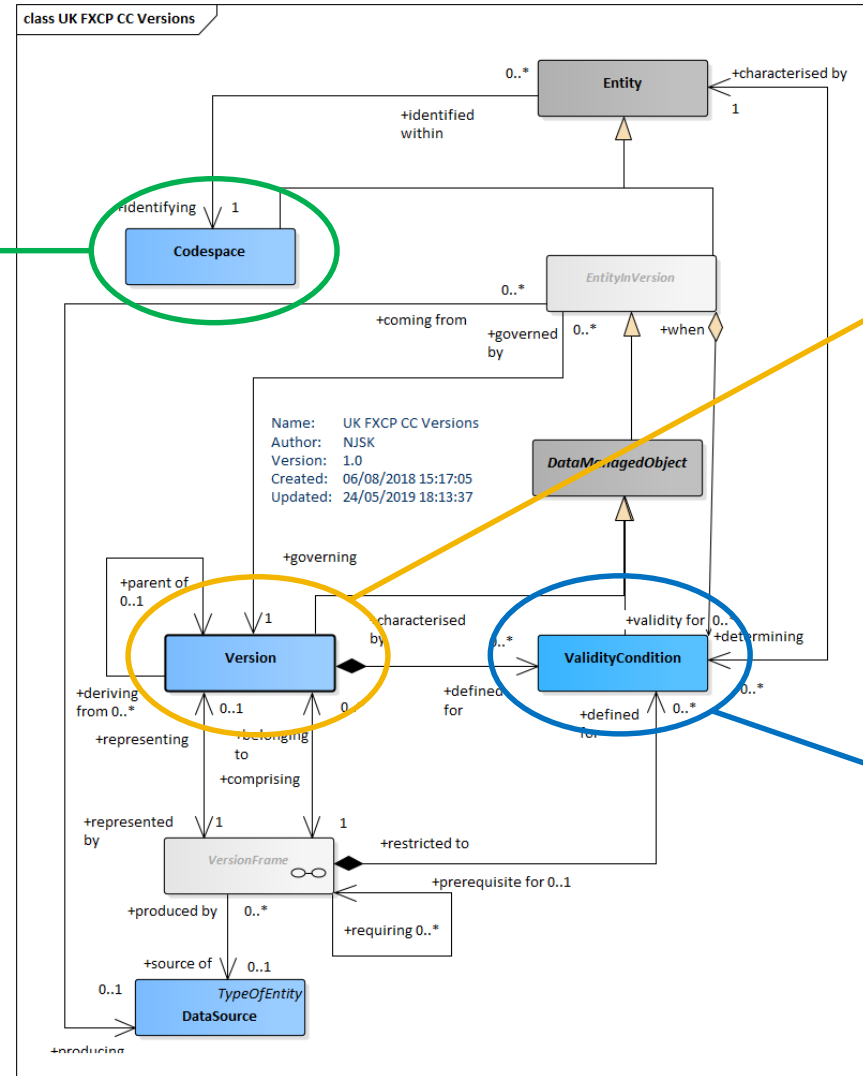- FXCP allows a specialised validity, AVAILABILITY CONDITION, which must contains a FROM DATE
- The data producer is responsible for ensuring validities do not conflict

class UK FXCP CC Versions

Entity

+characterised by
1

0..*

+identified within

+identifying
1

Codespace

+coming from

EntityInVersion

0..*

+governed by

0..*

+when

Name: UK FXCP CC Versions
Author: NJSK
Version: 1.0
Created: 06/08/2018 15:17:05
Updated: 24/05/2019 18:13:37

DataManagedObject

+governing

+parent of
0..1

characterised by

+validity for 0..
+determining

1

Version

ValidityCondition

0..*

+deriving from 0..*

0..1

0

+defined for

+defined
0..*

+representing

+belonging to

+comprising

+represented by
1

1

VersionFrame

+restricted to

+prerequisite for 0..1

+produced by
0..*

+requiring 0..*

+source of
0..1

0..1

TypeOfEntity
DataSource

+producing

UK National Codespace Definitions / Mappings

Prefix	URL	NPTG / NaPTAN / TXC elements	NeTEx
nptgLocality	http://naptan.org.uk/nptgLocality	NptgLocality	StopPlace Scheduled Stop Point
nptgTariffZone	http://naptan.org.uk/plusbus	PlusBusZone	TariffZone / FareZone
nptgAdminArea	http://naptan.org.uk/nptg	AdministrativeArea	ResponsibilitySet + (AdministrativeArea)
nptg	http://naptan.org.uk/nptg	NptgLocality. LocalityClassification (values)	TopographicPlaceType (+TypeOfPlace)
		NptgLocality. SourceLocalityType (values)	TypeOfPlace
naptStop	http:naptan.org.uk/stop_data	StopPoint	StopPlace ScheduledStopPoint
		StopArea	StopArea
txc	http:transxchange.org.uk/metadata	StopClassification	TypeOfPlace
		ServiceClassification	TypeOfService
		LicenceClassification	TypeOfOrganisation
noc	http:transxchange.org.uk/noc	Operator	Operator
vosa	http:vosa.gov.uk/vosa	LicenceNumber	ExternalOperatorRef

UK National Codespace Definitions (XML)

```xml
<codespaces>
    <Codespace id="napt">
        <Xmlns>naptStop</Xmlns>
        <XmlnsUrl>http://www.naptan.org.uk/stops</XmlnsUrl>
        <Description>UK National Public Transport ACcess Nodes databse and codes</Description>
    </Codespace>
    <Codespace id="nptg">
        <Xmlns>nptg</Xmlns>
        <XmlnsUrl>http://www.nptg.org.uk/nptg</XmlnsUrl>
        <Description>UK National Public Transport gazeteer and NPTG codes</Description>
    </Codespace>
    <Codespace id="noc">
        <Xmlns>noc</Xmlns>
        <XmlnsUrl>http://www.transxchange.org.uk/noc</XmlnsUrl>
        <Description>UK National Operator Code database codes</Description>
    </Codespace>
    <Codespace id="txc">
        <Xmlns>txc</Xmlns>
        <XmlnsUrl>http://www.transxchange.org.uk/operators</XmlnsUrl>
        <Description>UK Transxchange codes</Description>
    </Codespace>
    <Codespace id="mytim">
        <Xmlns>mytim</Xmlns>
        <XmlnsUrl>http://www.mytimetables.co.uk/data</XmlnsUrl>
        <Description>Sample TXC data</Description>
    </Codespace>
</codespaces>
```
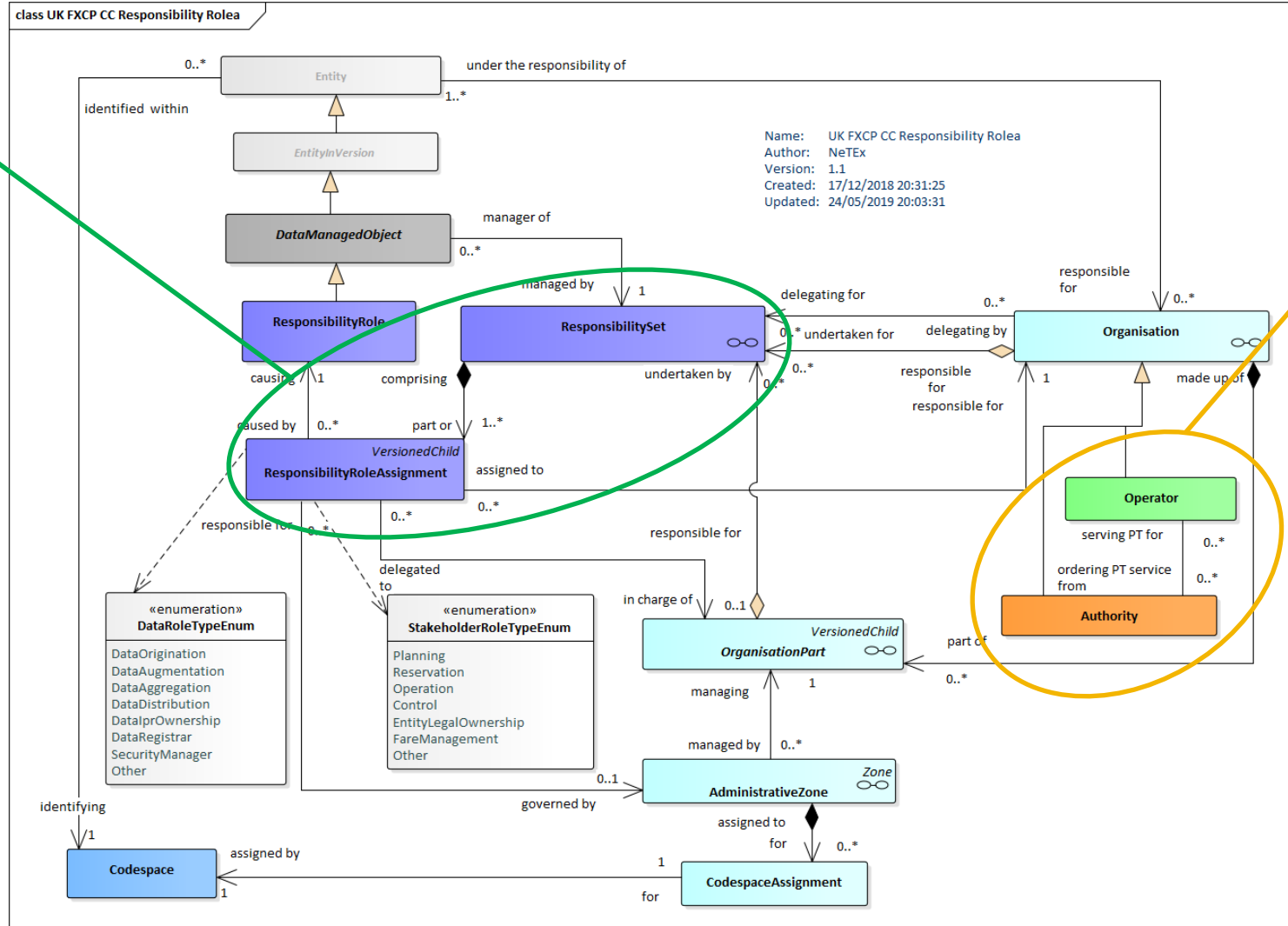
Examples of using Codespaces

```xml
<StopPlaceRef version="any" ref="naptStop:260010966">

<ScheduledStopPoint version="any" id="naptStop:260010944">
```

UML Diagrams : Operator

- Specifies the different roles that an organisation can have e.g. data creator, aggregator, etc.

- FXCP suggests (but doesn't require) a Responsibility Set to be assigned to organisation to denote that they are the provider of the data

class UK FXCP CC Responsibility Rolea

Name: UK FXCP CC Responsibility Rolea
Author: NeTEx
Version: 1.1
Created: 17/12/2018 20:31:25
Updated: 24/05/2019 20:03:31

«enumeration» DataRoleTypeEnum
DataOrigination
DataAugmentation
DataAggregation
DataDistribution
DataIprOwnership
DataRegistrar
SecurityManager
Other

«enumeration» StakeholderRoleTypeEnum
Planning
Reservation
Operation
Control
EntityLegalOwnership
FareManagement
Other

- An OPERATOR and an AUTHORITY are special type of ORGANISATION

- Generally interchangeable so where an Authority operates services, AUTHORITY can be used instead of OPERATOR

- FXCP requires Operator to be in a RESOURCE FRAME

- FXCP requires a NOC code to be used for an operator

Mapping TXC Operator Classifications to NeTEx

TransXChange LicenceClassification	NeTEx TypeOfOrganisation
standardNational	txc:LicenseClassification@standardNational
standardInternational	txc:LicenseClassification@standardInternational
restricted	txc:LicenseClassification@restricted
specialRestricted	txc:LicenseClassification@specialRestricted
communityBusPermit	txc:LicenseClassification@ communityBusPermit

Operator (XML)

```xml
<Operator created="2003-06-09T14:20:00-05:00" changed="2004-05-09T14:20:00-05:00" modification="revise" version="2" id="noc:SCWW" >
    <PublicCode>SCWW</PublicCode>
    <ExternalOperatorRef type="dvsa:LicenceNumber" ref="dvsa:PD0000479"/>
    <Name>Stagecoach</Name>
    <ShortName>Stagecoach</ShortName>
    <LegalName>Midland Red South Ltd</LegalName>
    <TradingName>Stagecoach in Warwickshire</TradingName>
    <ContactDetails>
        <Email>schedules.warwickshire@stagecoachbus.com</Email>
        <Phone>01788 566068</Phone>
    </ContactDetails>
    <typesOfOrganisation>
        <TypeOfOrganisationRef ref="txc:LicenceClassification@StandardNational" modification= "revise" version="txc:v2.1"/>
    </typesOfOrganisation>
    <Address id="noc:SCWW" version="2">
        <AddressLine1>Head Office</AddressLine1>
        <Street>Railway Terrace</Street>
        <Town>Rugby</Town>
        <PostCode>CV21 3HS</PostCode>
        <Province>Warks</Province>
    </Address>
    <PrimaryMode>bus</PrimaryMode>
    <CustomerServiceContactDetails>
        <Phone>0871 2002233</Phone>
    </CustomerServiceContactDetails>
</Operator>
```

For an example of an Operator with a **ResponsibilitySet**, see profile documentation

SERVICE CALENDAR holds information about when services run.

A DAY TYPE ASSIGNMENT relates a DAY TYPE to actual calendar dates

In FXCP, this is achieved with an OPERATING PERIOD (a range of dates)

TIME BAND allows particular times to be defined within a day type e.g. periods of congestion
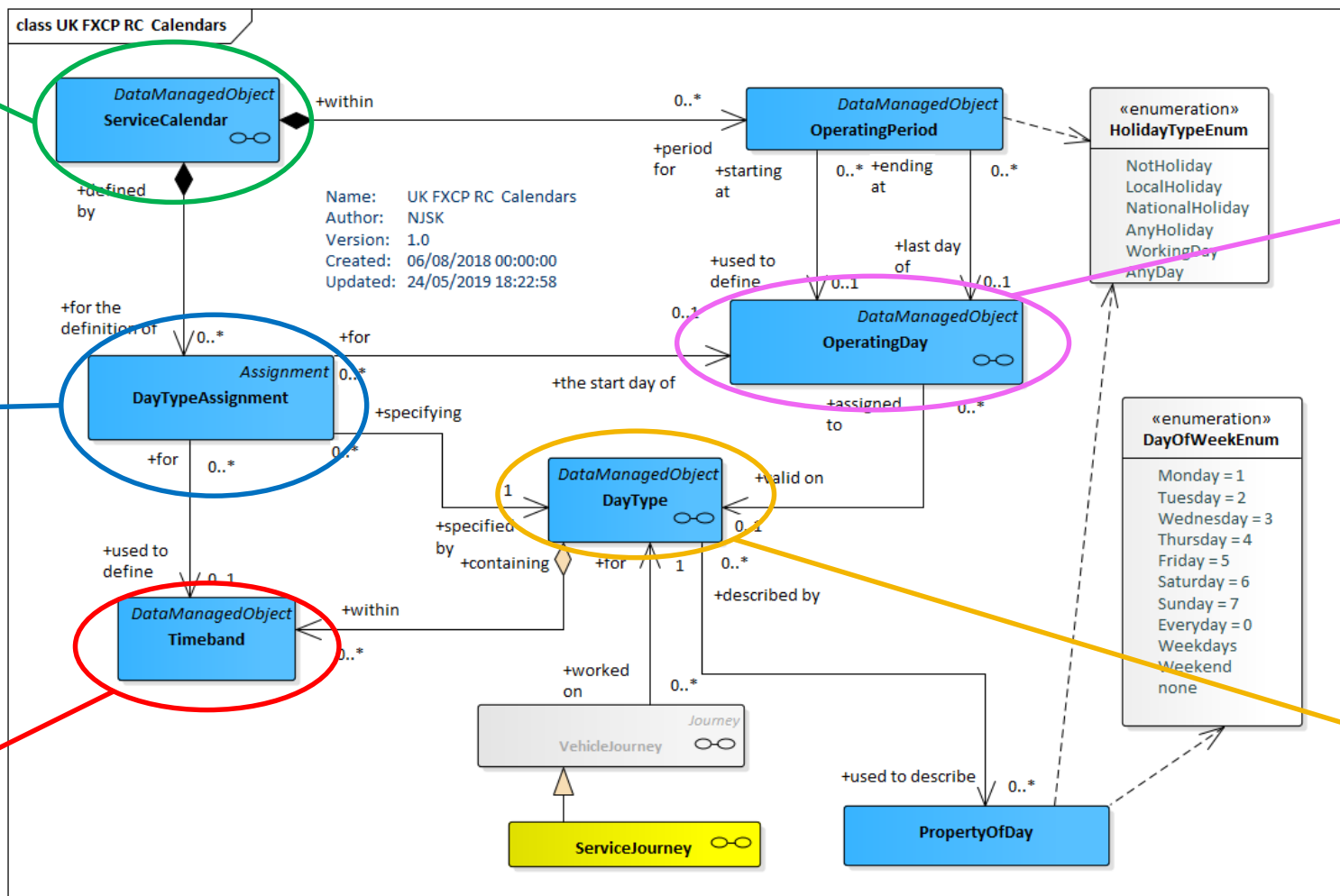
OPERATING DAY allows a non-calendar operating day to be defined e.g. 0400 to 0359 the next day.

DAY TYPE defines the various properties of a given operating day e.g. "Mondays to Fridays"

Separate from the calendar days when a service actually runs

Diagram: class UK FXCP RC Calendars

Name: UK FXCP RC Calendars
Author: NJSK
Version: 1.0
Created: 06/08/2018 00:00:00
Updated: 24/05/2019 18:22:58

«enumeration» HolidayTypeEnum
NotHoliday
LocalHoliday
NationalHoliday
AnyHoliday
WorkingDay
AnyDay

«enumeration» DayOfWeekEnum
Monday = 1
Tuesday = 2
Wednesday = 3
Thursday = 4
Friday = 5
Saturday = 6
Sunday = 7
Everyday = 0
Weekdays
Weekend

```xml
<ServiceCalendarFrame version="txc:v2.1" id="fxc:UK:DFT:ServiceCalendarFrame_UK_PI_CALENDAR:TXC:txc" responsibilitySetRef="txc:TransXChange_metadata"
dataSourceRef="txc:dft">
    <Name>Built in day types for TransXChange</Name>
    <codespaces>
        <CodespaceRef ref="txc_metadata"/>
    </codespaces>
    <dayTypes>
        <DayType version="txc:v2.1" id="txc:RegularDayType@monday-to-friday">
            <Name>Weekdays</Name>
            <properties>
                <PropertyOfDay>
                    <DaysOfWeek>Monday Tuesday Wednesday Thursday Friday</DaysOfWeek>
                </PropertyOfDay>
            </properties>
        </DayType>
        <DayType version="txc:v2.1" id="txc:RegularDayType@Christmas_eve">
            <Name>Christmas Eve</Name>
            <properties>
                <PropertyOfDay>
                    <DayOfYear>--12-24</DayOfYear>
                    <CountryRef ref="uk" refPrincipality="iso3166-2:GB-GBN"/>
                    <HolidayTypes>EveOfHoliday</HolidayTypes>
                </PropertyOfDay>
            </properties>
        </DayType>
        <!-- etc etc -->
    </dayTypes>
</ServiceCalendarFrame>
```

UML : Network Topology

- LINEs may be grouped to form a related set e.g. 1/1A, Essex supported services, Nottingham Night Bus
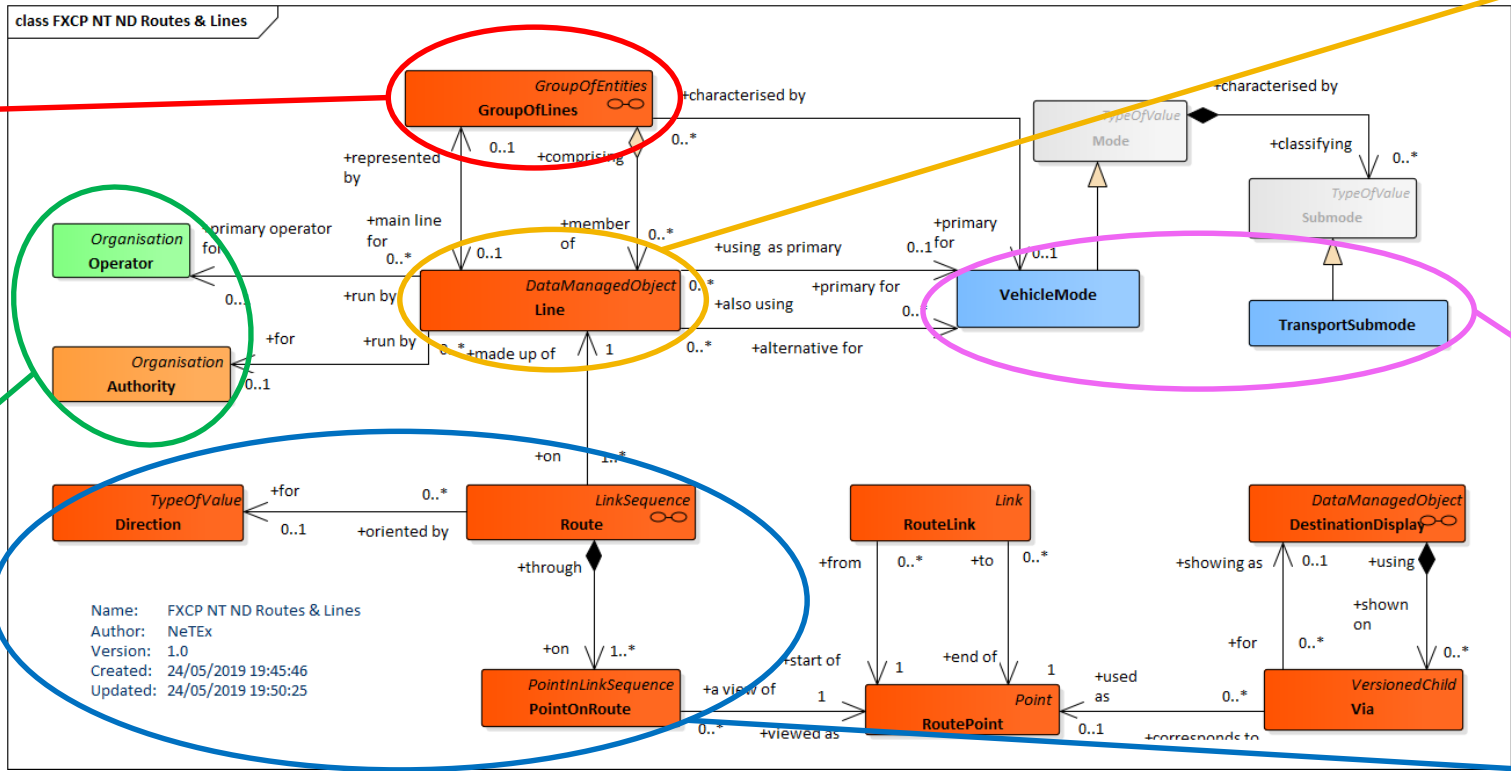
- A LINE is a grouping of (physical) ROUTEs known by a similar name or number

- A LINE is associated with a main VEHICLE MODE and (if applicable) TRANSPORT SUBMODE e.g bus / schoolBus or bus / railReplacementBus

- A LINE has a main OPERATOR or AUTHORITY

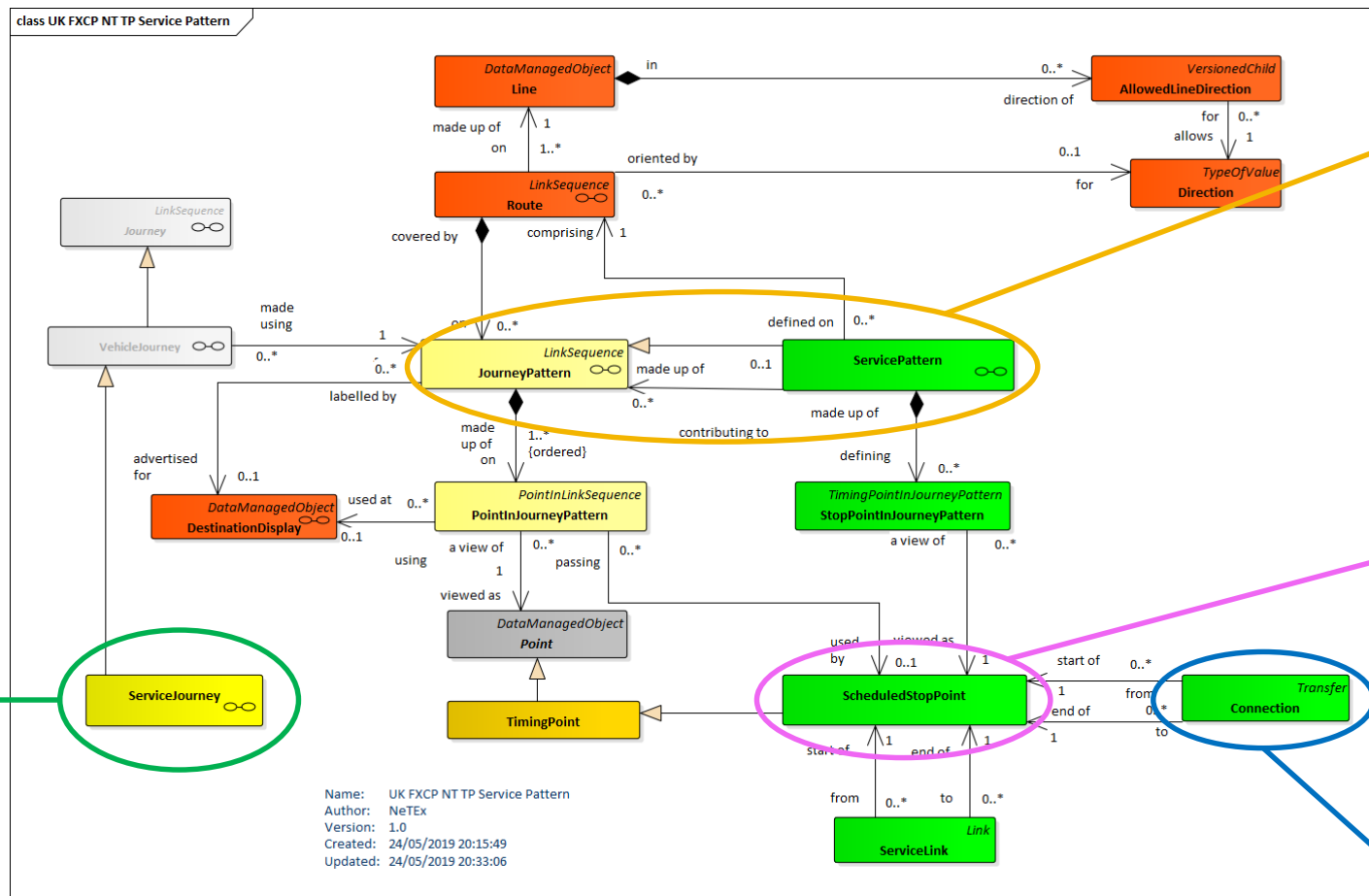- A ROUTE is a sequence of points or links in a given DIRECTION. FXCP uses POINT ON ROUTE.

class FXCP NT ND Routes & Lines

Name: FXCP NT ND Routes & Lines
Author: NeTEx
Version: 1.0
Created: 24/05/2019 19:45:46
Updated: 24/05/2019 19:50:25

Line (XML)

- Mapping of TXC *Line* element to NeTEx *Line* is straightforward

- A TXC *FlexibleService* maps to a NeTEx *FlexibleLine*

- Some elements can be populated from TXC *Service*
  - Use *TypeOfServiceRef* for TXC *ServiceClassification*
  - Use *AllowedLineDirection* for TXC service *Direction*

- Each LINE has to have a unique identifier within the operator's codespace.

- It is not unusual to have *Name* or *PublicCode* as non-unique values – that's OK so long as the *id* is unique

```xml
<Line version="1" id="stg:SCWW@86">
    <Name>86</Name>
    <Description>Stagecoach, Rugby, Line 86</Description>
    <PublicCode>86</PublicCode>
    <OperatorRef version="2" ref="noc:SCWW"/>
    <TypeOfServiceRef version="txc:v2.1" ref="txc:ServiceClassification@NormalStopping"/>
    <allowedDirections>
        <AllowedLineDirection version="1" id="stg:SCWW@86@outbound">
            <DirectionRef version="1" ref="stg:SCWW@86@outbound"/>
        </AllowedLineDirection>
        <AllowedLineDirection version="1" id="stg:SCWW@86@inbound">
            <DirectionRef version="1" ref="stg:SCWW@86@inbound"/>
        </AllowedLineDirection>
    </allowedDirections>
</Line>
```

UML : Service Patterns

JOURNEY PATTERNs describe how a vehicle works a given ROUTE.

A SERVICE PATTERN is a view of a JOURNEY PATTERN from the passenger point of view

A SERVICE JOURNEY PATTERN is an ordered list of SCHEDULED STOP POINTs where passengers board/alight

In FXCP, do not use TIMING POINT, only SCHEDULED STOP POINT.

A SERVICE JOURNEY is a passenger view of the SERVICE PATTERN a vehicle operates (trip) with PASSING TIMES allocated to each stopping point

Connections between stops can be defined

- Only basic information needs to be present

- The stop code can be assumed to imply the existence of a STOP PLACE ASSIGNMENT to a STOP PLACE with the same code

```xml
<ScheduledStopPoint version="1" id="naptStop:4200F009301">
    <Name>Oakdale Road</Name>
    <NameSuffix>Opp</NameSuffix>
    <StopType>onstreetBus</StopType>
    <TopographicPlaceView>
        <Name>Binley Woods</Name>
    </TopographicPlaceView>
</ScheduledStopPoint>
```
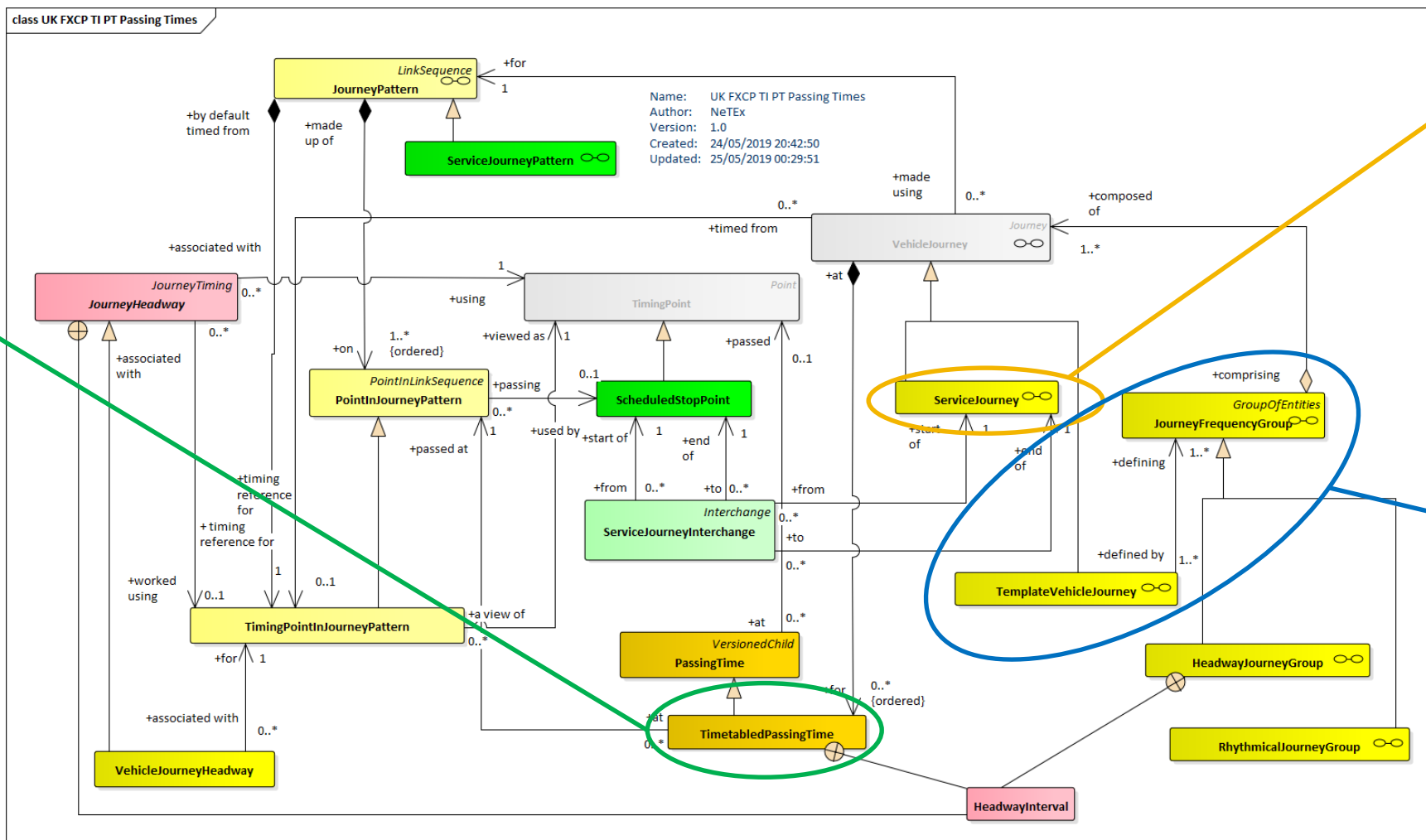
Service Journey Patterns (XML)

- There is a direct equivalence between TXC *JourneyPattern* and NeTEx *ServiceJourneyPattern*.

- There isn't an equivalent to TXC *JourneyPatternSection*.
  - Instead, populate the NeTEx *ServiceJourneyPattern* with the entire list of *ScheduledStopPoint* instances

- Additionally, reference an onward *ServiceLink* corresponding to the TXC *JourneyPatternTimingLink*.

```xml
<ServiceJourneyPattern version="1" id="sta:SCWW@894416@">
    <Name>Rugby - Coventry</Name>
    <DirectionType>outbound</DirectionType>
    <TypeOfJourneyPatternRef version="txc:v2.1" ref="txc:Type_of_JourneyPattern@JourneyPattern"/>
    <pointsInSequence>
        <StopPointInJourneyPattern version="1" id="sta:SCWW@894416@1" order="1">
            <ScheduledStopPointRef version="1" ref="naptStop:43000001304"/>
            <OnwardServiceLinkRef version="1" ref="sta89441:JourneyPatternTimingLink@4"/>
        </StopPointInJourneyPattern>
        <StopPointInJourneyPattern version="1" id="sta:SCWW@894416@2" order="2">
            <ScheduledStopPointRef version="1" ref="naptStop:43000007102"/>
            <OnwardServiceLinkRef version="1" ref="sta89441:JourneyPatternTimingLink@5"/>
        </StopPointInJourneyPattern>
        <!-- etc etc -->
    </pointsInSequence>
</ServiceJourneyPattern>
<!-- etc etc -->
```

UML : Service Journey and Passing Time

Timetabled times at stops where passengers can board or alight are TIMETABLED PASSING TIMEs

Use *DepartureDay Offset* for trips that run in the early hours of the next calendar day

SERVICE JOURNEY is a passenger VEHICLE JOURNEY.

FXCP does not use DEAD RUNs

Journeys can be specified as frequent services using a TEMPLATE VEHICLE JOURNEY / JOURNEY FREQUENCY GROUP

UML : Service Journey
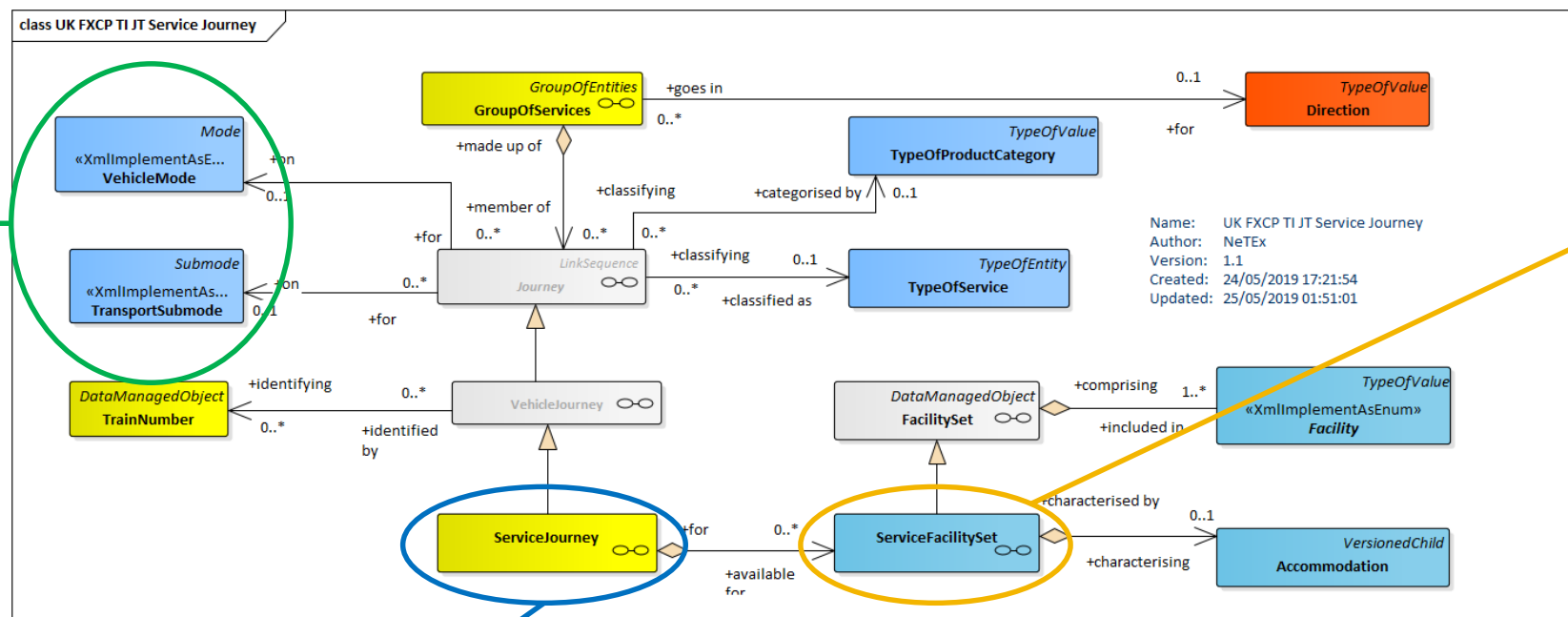
A vehicle type may be assigned to a specific SERVICE JOURNEY

The facilities available to the passenger may be denoted by the use of a SERVICE FACILITY SET

Connections between different SERVICE JOURNEYs (e.g. terminal loops, circular services, change of line name on same vehicle) are possible using a SERVICE JOURNEY INTERCHANGE or JOURNEY PART / JOURNEY PART COUPLE [not shown]
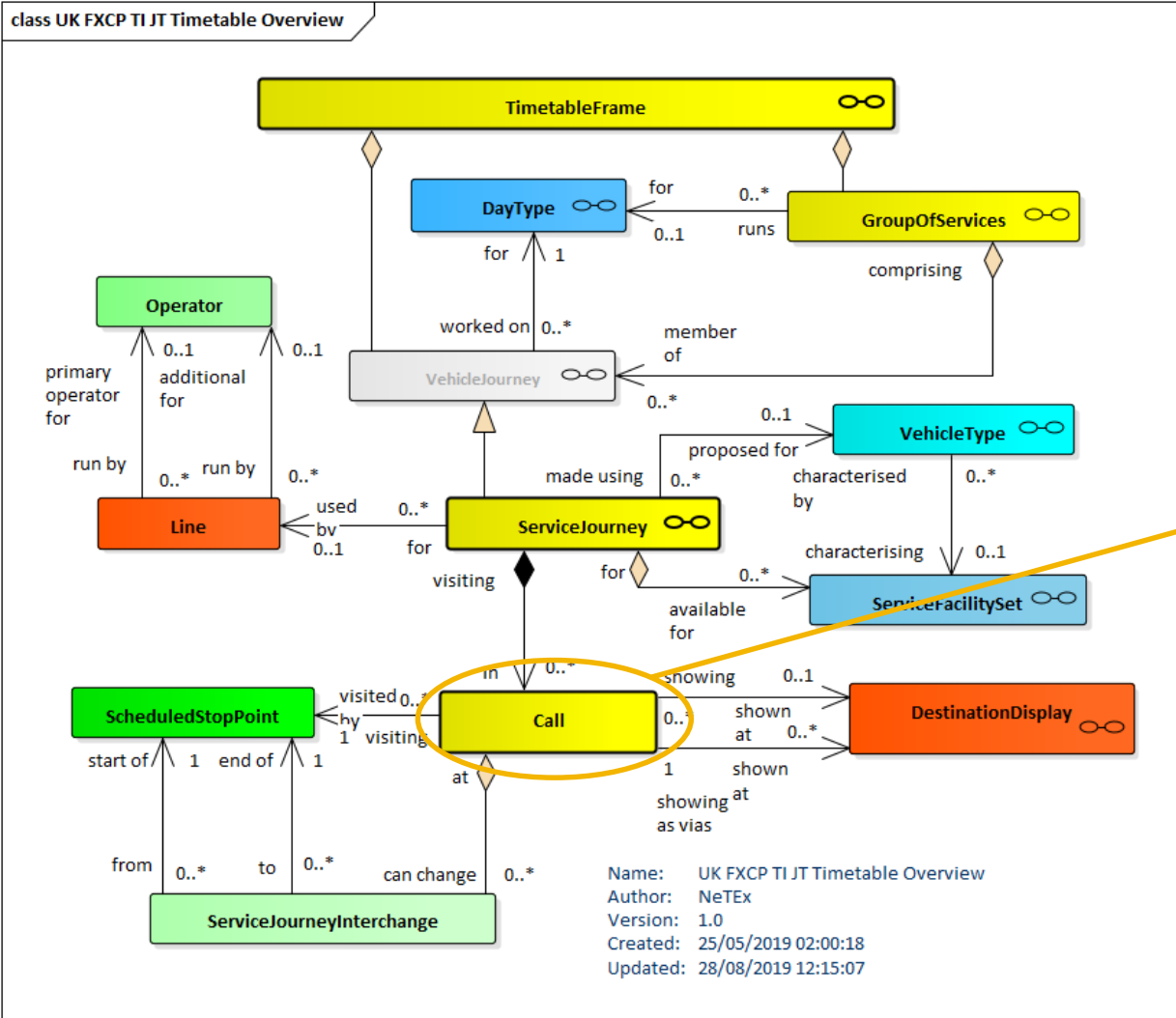
- A CALL is a representation of the details of a SERVICE JOURNEY that is more efficient to process
  - o Stores e.g. RUN TIMEs, WAIT TIMEs in context
- FXCP can use CALLs as well as TIMETABLED PASSING TIMES (recommended)
  - o One CALL for each end of a TXC *VehicleJourneyTimingLink*
    - Incoming end ⇒ *Call.Arrival*
    - Outgoing end ⇒ *Call.Departure*
  - o Use *ServiceLink* as the *OnwardTimingLink*
    - Can add *RunTime* to the *OnwardTimingLink* (matches TXC)
  - o Can add *WaitTime* to Departure

```xml
<ServiceJourney version="1" id="sta:SCWW@894416">
    <DepartureTime>07:32:00</DepartureTime>
    <dayTypes>
        <DayTypeRef version="any" ref="hde:DT_02-Monday+Sunday_NotHoliday"/>
    </dayTypes>
    <ServiceJourneyPatternRef ref="sta:SCWW@894416@1"/>
    <BlockRef versionRef="EXTERNAL" ref="121"/>
    <LineRef version ="1" ref="sta:Line@2"/>
    <DirectionType>outbound</DirectionType>
    <groupsOfServices>
        <GroupOfServicesRef version="1" ref="sta:Service@R86@out@monday-to-friday"/>
    </groupsOfServices>
    <passingTimes>
        <TimetabledPassingTime version="any" id="sta:SCWW@894416_01">
            <StopPointInJourneyPatternRef version="any" ref="sta:SCWW@894416@1" order="1"/>
            <DepartureTime>07:32:00Z</DepartureTime>
        </TimetabledPassingTime>
        <TimetabledPassingTime version="any" id="sta:SCWW@894416_02">
            <StopPointInJourneyPatternRef version="any" ref="sta:SCWW@894416@1" order="2"/>
            <DepartureTime>07:40:00.0Z</DepartureTime>
        </TimetabledPassingTime>
        <!-- etc etc -->
    </passingTimes>
```

```
...
<calls>
        <Call id="sta:SCWW@894416" version="1" order="1">
                <ScheduledStopPointRef version="1" ref="naptStop:43000001304"/>
                <OnwardTimingLinkView>
                        <TimingLinkRef version="1" ref="sta89441:JourneyPatternTimingLink@4"/>
                        <RunTime>PT8M0S</RunTime>
                </OnwardTimingLinkView>
                <TimingPointStatus>timingPoint</TimingPointStatus>
                <Arrival>
                        <ForAlighting>false</ForAlighting>
                </Arrival>
                <Departure>
                        <Time>07:32:00Z</Time>
                </Departure>
        </Call>
        <Call id="sta:SCWW@894416" version="1" order="2">
                <ScheduledStopPointRef version="1" ref="naptStop:43000007102"/>
                <OnwardTimingLinkView>
                        <TimingLinkRef version="1" ref="sta89441:JourneyPatternTimingLink@5"/>
                        <RunTime>PT1M7S</RunTime>
                </OnwardTimingLinkView>
                <TimingPointStatus>timingPoint</TimingPointStatus>
                <Departure>
                        <Time>07:40:00Z</Time>
                        <WaitTime>PT2M</WaitTime>
                </Departure>
        </Call>
</calls>
</ServiceJourney>
```
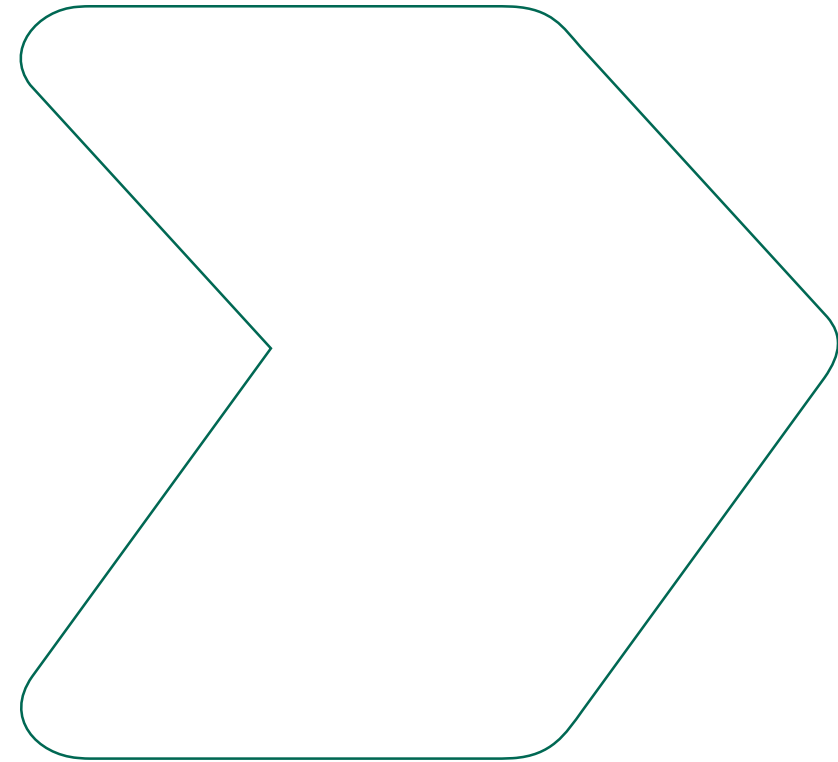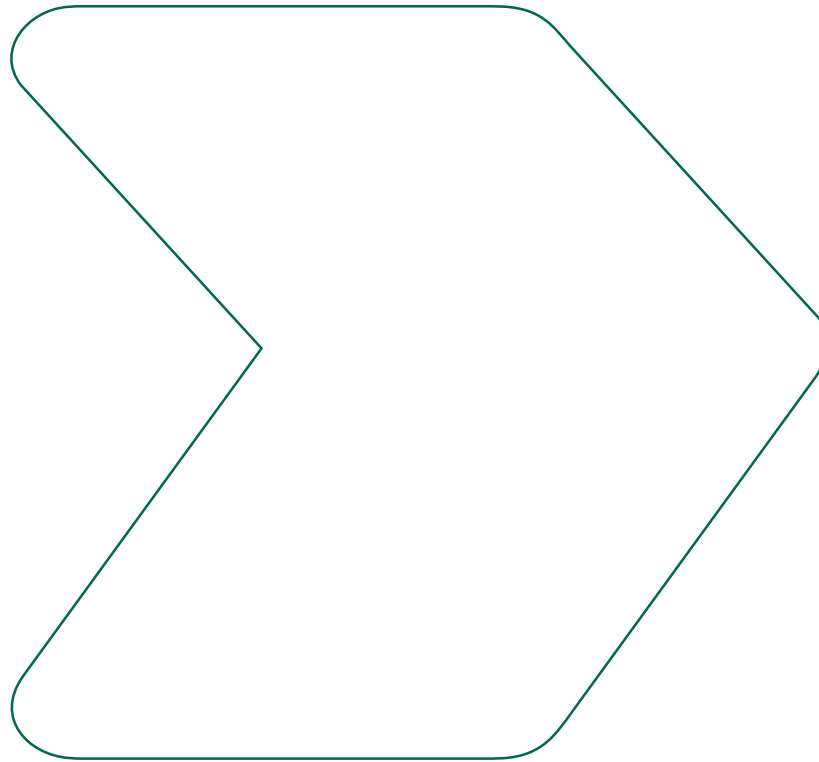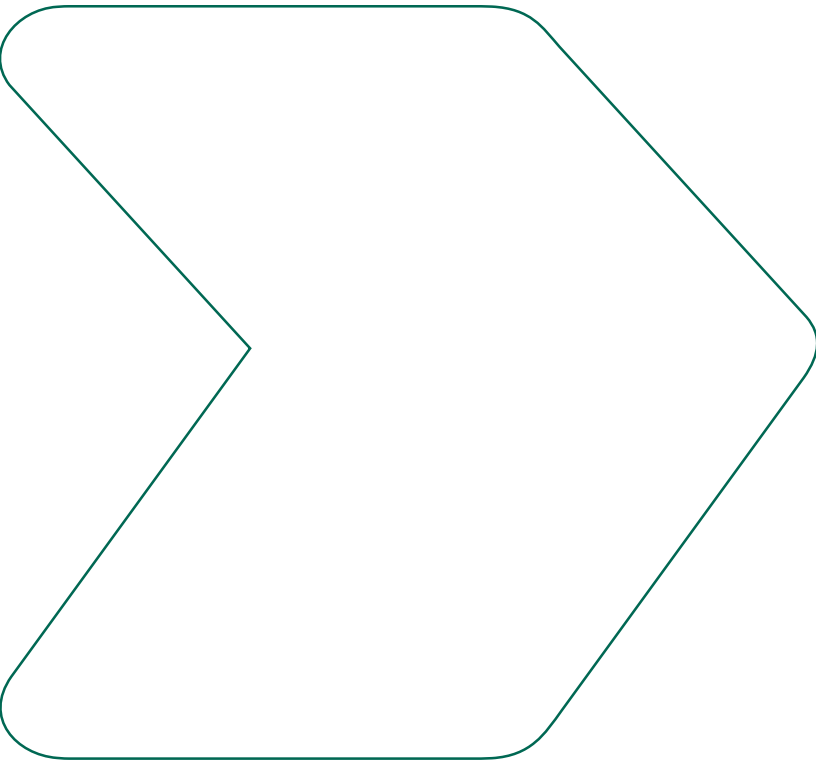
Using NeTEx for Routes and Timetables

3. Key Equivalencies

Key Equivalencies between NeTEx and TransXChange
1. NeTEx "Resource" Frames

TransXChange	NeTEx Frame	NeTEx	Comment
TransXChange	CompositeFrame	ServiceFrame, TimetableFrame	
NptgLocality	SiteFrame	TopographicPlace	
ServicedOrganisation	ResourceFrame	ServicedOrganisation	
Operator	ResourceFrame	Operator	
VehicleType	ResourceFrame	VehicleType	
OperationalProfile / RegularDayType, PeriodicDayType, BankHolidayOperation	ServiceCalendarFrame	DayType + PropertiesOfDay	Predefined day type s p rovided as FXC Pmetadata
ServiceCalendar	ServiceCalendarFrame	ServiceCalendar	

TransXChange	NeTEx Frame	NeTEx	Comment
StopPoint	ServiceFrame	ScheduledStopPoint + StopAssignment + StopPlace	
StopArea	ServiceFrame	StopArea	
RouteSection	ServiceFrame	(GeneralSection)	optional
Route	ServiceFrame	Route	
JourneyPatternSection	ServiceFrame	(GeneralSection)	optional
JourneyPattern	ServiceFrame	ServiceJourneyPattern	
JourneyPatternSection	ServiceFrame	(GeneralSection)	optional
JourneyPatternTimingLink	ServiceFrame	StopPointInPattern +TimingLink + TimingPattern +	
Line	ServiceFrame	Line	
OperationalProfile		DutyCrew, Block	
Direction	ServiceFrame	Direction	
Mode	ServiceFrame	VehicleMode	
ServiceAvailability	ServiceFrame	TimeDemandType	
VehicleJourneyTimingLink	ServiceFrame	StopPointInPattern (+Onward ServiceLink + Run Time + Wait TIme) + TimetabledPassingTime	Passing times must be computed

TransXChange	NeTEx Frame	NeTEx	Comment
Service	TimetableFrame	Line + GroupOfServices	(JourneyGroupings)
StandardService	TimetableFrame	(Line + GroupOfServices)	
FlexibleService	TimetableFrame	FlexibleServiceProperties	
InboundJourneyGrouping	TimetableFrame	GroupOfServices + Direction	Fixed Day type 7 Direction
OutboundJourneyGrouping	TimetableFrame	GroupOfServices + Direction	Fixed Day type 7 Direction
CustomJourneyGrouping	TimetableFrame	GroupOfServices + Direction	
ServiceClassification	TimetableFrame	TypeOfService	FXCP Value set
VehicleJourney	TimetableFrame	ServiceJourney, TemplateServiceJourney	
JourneyPatternInterchange	TimetableFrame	ServiceJourneyInterchange	

THANK YOU

Any questions?

Please contact Julie Williams

julie.williams@traveline.info