

TfNSW TransXChange Implementation Specification

(Using TransXChange at TfNSW)

Version 2.5.10

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Specification Governance

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2.5.8	Draft circulated for review by the Public Transport Real-Time Working Group.	18 Mar 2019	Included feedback received from DCIS and the PTMS project team.
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1 Introduction

TransXChange (TXC) is an Extensible Mark-up Language (XML) based data interchange format designed to meet the needs of transport agencies for exchanging information about routes, timetables and related data items. The origin of the TransXChange specification was the United Kingdom, circa 2008, and the author, Nick Knowles of Kizoom, also contributed extensively to the European community effort to create a conceptual data model, known as TransModel.

Many transport agencies - Transport for NSW (TfNSW) included - have implemented their own localisations atop that base implementation, with the expectation that any implementation will comply with these localisations.

1.1 Document Purpose

TransXChange has been specified in commercial contracts between TfNSW, Operating Agencies and Private Operators as the means to supply data describing the contracted schedule. Thus, TfNSW has prepared this document to provide guidance and technical requirements to Operators as well as to recipients of TransXChange data sets. It aims to present the schema in a readable format and describe the key concepts and relationships that make up this domain.

Note: TransXChange for TfNSW has not been developed with the intention that it should be suitable for use by other external agencies. TfNSW accepts no responsibility for use of 'TransXChange for TfNSW' by external agencies and will not provide support or assistance.

1.2 Why is a TfNSW TransXChange Implementation Specification Needed?

The TfNSW TransXChange Implementation Specification is required to:

- Localise the TransXChange specification to TfNSW needs
- Reduce the complexity and risk of divergent implementations; if there are multiple ways of doing the same thing then this specification 'localises' each implementation to a single way, based on best practise, communications and processing efficiency, and requirements
- Ensure a consistent interpretation of the UK TransXChange schema
- Describe relevant TfNSW business rules that are needed to supplement the TransXChange schema
- Define TransXChange information sharing rules
- Define common terminology.

1.3 Intended Audience

The intended audience of this document are technical resources of TfNSW, Operating Agencies and Private Operators as well as System Integrators who will be responsible for the design and implementation of the AVM and scheduling systems. This includes:

- Data Architects for the accurate mapping of elements used in delivering the solution;
- Solution Designers for the detailed implementation framework of the AVM and scheduling systems;
- Developers for the configuration and delivery of the technical solution; and
- Testers for ensuring the solution meets the requirements of TfNSW as specified.

TfNSW Use Cases have been defined to assist new TfNSW TransXChange Community members in their understanding of TransXChange data sets and guide consistent implementation.

1.4 Assumed Knowledge

Readers responsible for implementing TransXChange must be familiar with:

- TransXChange standards
- Real-time public transport data
- Communication protocols
- TfNSW wayfinding and network terminology
- TfNSW SIRI specification
- Transmodel abstract relationship framework.

1.5 Document Structure

Table 1 – Chapters Contained Within This Document

Chapter No.	Chapter Name	Description
1	Introduction	Document purpose, structure, intended audience, references and change management process.
2	TfNSW Consistent Language Glossary	Lists common TfNSW terms and their meaning, with the aim of encouraging a common language between data producers, data managers and data consumers.
3	Global TransXChange Concepts	Familiarises readers with key constructs and terminology that form part of the TransXChange international standard.
4	TfNSW TransXChange Implementation Approach	Introduces the data elements and relationships that can be described by a TfNSW TransXChange document.
5	TfNSW TransXChange Schema	Details the attributes within each of the elements and sub-elements in the TfNSW TransXChange schema.
6	TfNSW TransXChange Use Cases	Provides examples of the data to be supplied by Public Transport Operators in a variety of “real life” scenarios.
-	Appendices	TransXChange vs NeTEx comparison; TransXChange to GTFS mapping.

1.6 Document References

1.6.1 TransXChange Artefacts

The primary TransXChange artefacts are illustrated below. The most generic of these, pictured at left, are the TransXChange Schema Guide developed by the UK Government and the XML Schema Definition (XSD) that underpins it.

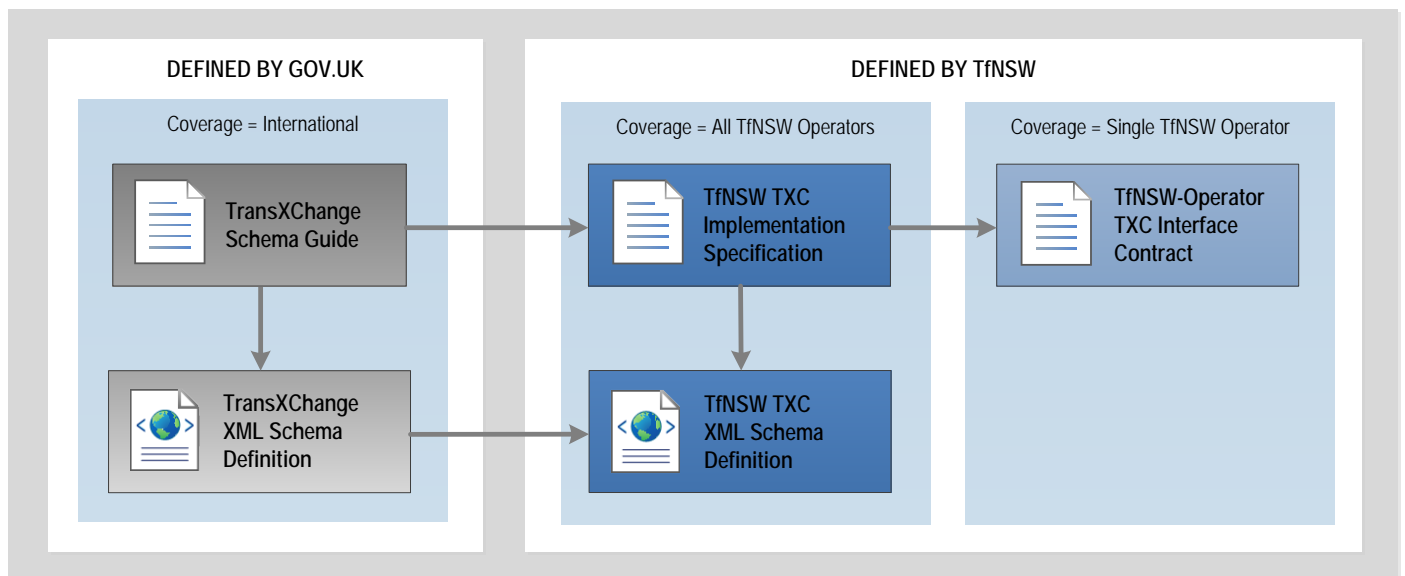


Figure 1- Inter-Relationship Between TransXChange Artefacts

The TransXChange Implementation Specification (i.e. this document) focuses on the data needs of TfNSW and, as such, has a more limited scope than the international schema. Similarly, the TfNSW XSD is a cut-down version of the international XSD.

The TransXChange Interface Contracts issued by TfNSW are operator-specific and provide additional guidance on the use of TransXChange, tailored to the Operator in question.

Table 2 - TransXChange Document Locations

Document Name	Network Location or Documentation Link
TransXChange XML Schema Guide	http://naptan.dft.gov.uk/transxchange/schema/schemas.html Note: The TfNSW TransXChange Implementation Specification is based is v2.5.58.
TransXChange XML Schema Definition	http://www.transxchange.org.uk/schema/2.5/TransXChange_general.xsd Note: The TfNSW TransXChange XML Schema Definition is based is v2.5.
TfNSW TransXChange Implementation Specification	This document is published on TfNSW's web page at: https://www.transport.nsw.gov.au/system/files/media/documents/2019/TfNSW-TransXChange-Implementation-Specification.pdf
TfNSW TransXChange XML Schema Definition	The URL for the TfNSW XSD is as follows: https://portal.azure.com/#blade/Microsoft_Azure_Storage/FileShareMenuBlade/overview/storageAccountId/%2Fsubscriptions%2Fae44f1f6-8b48-4b2a-8187-2ddfbbe0315f%2FresourceGroups%2FTOS-MNP-PTM-XSD-RGP-001%2Fproviders%2FMicrosoft.Storage%2FstorageAccounts%2Fptmxsdstore/path/ptms

1.6.2 References to Other Standards

1.6.2.1 SIRI

Service Interface for Real Time Information (SIRI) is an XML protocol to allow distributed computers to exchange real time information about public transport schedules, vehicles, and connections, together with general informational messages related to the operation of the services.

SIRI is based on the [Transmodel](#) abstract model for public transport information, and comprises a general purpose model, and an XML schema for public transport information.

TfNSW provides this document in conjunction with the SIRI 2.0-TfNSW Implementation Specification as a specification group to describe the inter-operation between planned services and the real-time monitoring of services.

Table 3- SIRI Document Locations

Document Name	Network Location or Documentation Link
SIRI Standard Specification	SIRI standard specification can be found at : https://en.wikipedia.org/wiki/Service_Interface_for_Real_Time_Information#Current_version_&_Documentation OR under control https://www.vdv.de/siri.aspx
TfNSW SIRI Implementation Specification	This document is published on TfNSW's web page at: https://www.transport.nsw.gov.au/system/files/media/documents/2019/SIRI-2.0---TfNSW-Implementation-Specification---Using-SIRI-at-TfNSW.pdf

1.6.2.2 TransModel

The overlay of TransXChange and SIRI atop the TransModel 6.0 conceptual data model is intended to maximise the range of available application vendors providing software support for public transport. TfNSW seeks to guide within the above standards, localising minimally.

Table 4 - TransModel Document Location

Document Name	Network Location or Documentation Link
Transmodel CEN v6	CEN V6 http://transmodel-cen.eu/

1.7 Security Classification

This document is unclassified.

1.8 Change Management

The TfNSW Operational Systems Public Transport (PT) Real-Time Working Group will continue using and maintaining this document once published. Where a change is necessary across Operating Agencies and Private Operators supplying TransXChange to TfNSW, each impacted supplier will be engaged for change management.

2 TfNSW Consistent Language Glossary

This chapter lists common TfNSW terms and their meaning, with the aim of encouraging a common language between data producers and data consumers.

Table 5 – TfNSW Consistent Language Glossary

Terms	Alias/Alternative (acceptable usage)	Terms not to be used	Definition and Usage
Asset	-	-	An asset is any public transport vehicle, place, or facility used to facilitate transportation services to the Customers of TfNSW.
AVM system	-	-	Automatic Vehicle Monitoring system allows an Operator to produce and consume real-time information in the SIRI protocol about the public transport services it has been contracted to perform.
Consumer	-	-	An entity that receives notification messages or data from a Producer as a result of a previous subscription made to a service or a request for data.
Customer	-	-	A user of the state public transport network or timetable services.
Customer Journey	-	Trip	This is a TfNSW OPAL and Customer centric concept, included here for completeness. One or more Customer trips on eligible services where transfers between services occur within allowable transfer times.
Dated Vehicle Journey	Trip (acceptable when referring to vehicles rather than Customers) Service	-	A particular journey of a vehicle on a particular day.
Facility	-	-	Facility is equipment or service that provides a specific convenience or service to a Customer. E.g. Ticket machines, elevators, mechanical stairs (escalators), toilets. A facility may be equipment, a service, a personal device or a reserved area.
Flexible Service	-	-	Operates between catchment areas that can be made up of both spatial zones, and lists of fixed stops, allowing combinations of area-to-fixed stop, area-to-area, fixed stop-to fixed stop. When operating in a spatial zone, there might be no fixed or marked stop, but the service will call on demand.
Frequency Based Service	Headway Service	-	A frequent service whose time of departure is normally shown to the public as 'every n minutes' rather than a fixed time. For example 'every 5 minutes' or 'every 15 minutes'.
Frequent Service	-	-	A Frequency Based Service which meeting a regulatory/statutory requirement. Note: Not currently applicable for TfNSW as this is a London Transport legal concept.
Hail and Ride Area	-	Hail and Ride	A catchment zone for a hail and ride service, implemented as a named zone visited by a particular mode of transport and may be designated by a start point and end point on the road.

Terms	Alias/Alternative (acceptable usage)	Terms not to be used	Definition and Usage
Hail and Ride Service	-	Hail and Ride	A service that stops anywhere on designated parts of the route, if flagged down by passengers where it is safe to do so.
Incident	-	-	An unforeseen event affecting, usually to the detriment of, the operation of the Transport network.
Journey Pattern	-	-	An ordered list of Scheduled Stop Points and Timing Points on a single Route, describing the pattern of working for public transport vehicles. A Journey Pattern may pass through the same point more than once.
Line	-	-	A group of Journey Patterns (Routes) which is generally known to the public by a similar name or number.
Loop Service	Loop	-	A type of Service, conducted on a Journey Pattern that forms a circle or loop. The first and last TSNs are the same.
Monitored Vehicle Journey	-	-	A journey that is monitored as being operated by a logical vehicle. A Monitored Vehicle Journey relates to a single Dated Vehicle Journey.
Mode	-	-	A means of transport, such as bus, train, ferry, light rail.
Network	-	-	A named grouping of Lines under which a transport network is known.
OpenData	-	-	TFNSW OpenData hub https://opendata.transport.nsw.gov.au/
Operator	-	-	A company providing public transport services under the authority of TfNSW.
Passenger	-	-	Not to be used. Preferred term is Customer.
Passenger Information Display (PID)	-	-	A customer display showing transport information e.g. vehicle, platform and wharf timetable indicator boards.
Preview Interval	-	-	The AVM system in charge shall provide a prediction for all trips that run within the prediction window. This includes every trip for which any scheduled or real-time arrival and departure time at a stop of the trip is between now and preview interval in the future.
Publisher	-	-	An entity that processes events in the data feeds and sends Notification messages to a Producer for brokering and distribution to Consumers. Note: The Producer may carry out additional mediation such as filtering or data transformation. The use of a Notification Producer is transparent in SIRI.
Reference Data	-	-	Data external to the Operational Data Exchange which operational systems use such as specific positions, vehicle attributes, or facilities. E.g. Details of TSNs that we refer to in SIRI messages is reference data.
Requestor	-	-	General Software Term - an entity that makes a Request to a Service to ask it to perform an action or send a reply.

Terms	Alias/Alternative (acceptable usage)	Terms not to be used	Definition and Usage
Route	-	-	An ordered list of points (stops/timing) defining one single path through the road or rail network. The physical path taken by a vehicle on the service as a set of route links. (Note: A GTFS <i>Route</i> is a Transmodel <i>Line</i>)
Stop Point	Scheduled Stop Point	Stop Place Stop	A point where passengers can board or alight from vehicles.
Subscriber	-	-	An entity that acts as a Service Requestor, sending a Subscription Request on behalf of a Consumer to a Notification Producer Note: The Consumer entity will usually be the same entity as the Subscriber, but may also be a separate entity.
Transfer (of a Customer)	-	-	<i>This is a TfNSW OPAL and Customer centric concept, included here for completeness.</i> A transfer occurs at the end of a single trip. It is a change of transport mode or route, to another service or route, to continue a journey. Transfers made within a standard transfer time combine trips into a single journey.
Trip (for a Vehicle)	Dated Vehicle Journey	Journey	A particular journey of a vehicle on a particular operating day. Note: This document does not use 'trip' to refer to a Customer trip.
Trip-id	-	-	A unique identifier for Dated Vehicle Journey.
Vehicle	-	-	A public transport vehicle used for carrying passengers.
Vehicle Journey	-	-	The planned movement of a public transport vehicle on a day from the start point to the end point of a Journey Pattern on a specified Route. (i.e. a scheduled journey in a timetable)

Legend note: The use of dash in the table above indicates inapplicable.

3 Global TransXChange Concepts

The purpose of this chapter is to familiarise readers with key concepts and terminology embodied within the international TransXChange standard.

3.1 XML Document Structure

The structure of each TransXChange data set (XML document) is pictured below and consists of a single root element that holds one or more container elements, each of which holds one or more data elements with one or more attributes. A definition of each of these component parts is provided immediately after the diagram.

A data element may, in turn, include one or more containers. In other words, lower level containers may be nested within any of the data elements.

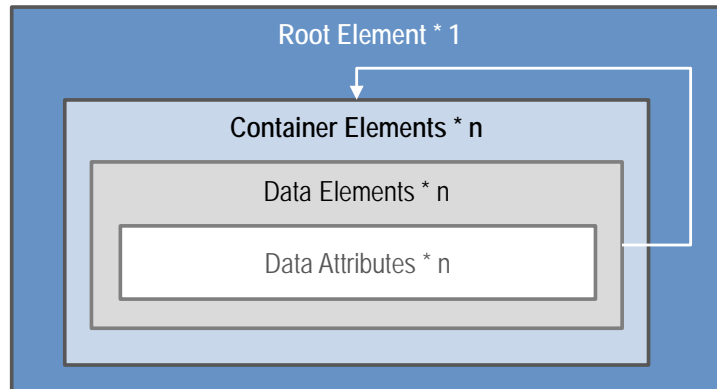


Figure 2 - Structural Components Within a TransXChange Data Set

3.1.1 Root Element

Every TransXChange document commences with a TransXChange root element, which encompasses all the other elements. It includes metadata describing the dataset, such as the creation timestamp and schema version.

3.1.2 Container Elements

A TransXChange container holds lists of elements of a particular type. The naming convention for container elements is that the container name is the plural of the elements within it. For example, the *StopPoints* container contains one or more *StopPoint* data elements.

3.1.3 Data Elements and Attributes

XML is a flexible standard by which it is valid to store information as an element or an attribute value. While both approaches are valid, the convention for TransXChange is for elements to correspond to data tables, and attributes to correspond with data items.

3.2 Documentation Conventions

3.2.1 TransXChange Versions

The naming convention (e.g. 2.5.0) has three elements separated by full stops in the form:

`TXC_<version>.<release>.<modification>`

The significance of the elements is as follows:

Table 6 – TransXChange Naming Convention

Element	Meaning
Version	A major planned revision to the specification
Release	An enhancement to the specification that is not compatible with the previous revision
Modification	An enhancement to the specification that is compatible with the previous revision. For example,

Element	Meaning
	the addition of an optional attribute to an element – existing files would pass validation against the revised schema definition, thus data providers would not need to modify their systems at the same time as receiving systems, unless they wished to make use of the new features.

3.2.2 XML Elements in Text

Throughout the (international) TransXChange XML Schema Guide:

- XML elements are shown in bold italic type, for example the *JourneyPattern* element
- XML attributes are shown in bold, for example **OperatorShortName**
- Containment of a sub-element by another element is shown by a forward slash, for example *Operator / Garage*.

These same conventions have been carried forward to this document.

3.2.3 UML Diagrams

Unified Modelling Language (UML) notation is used for class diagrams to show the formal structure of the TransXChange logical data model. The diagrams express structure in terms of classes, connected by association and composition relationships.

Relationships between container and contents are represented by composition. Association relationships are used to represent key reference relationships.

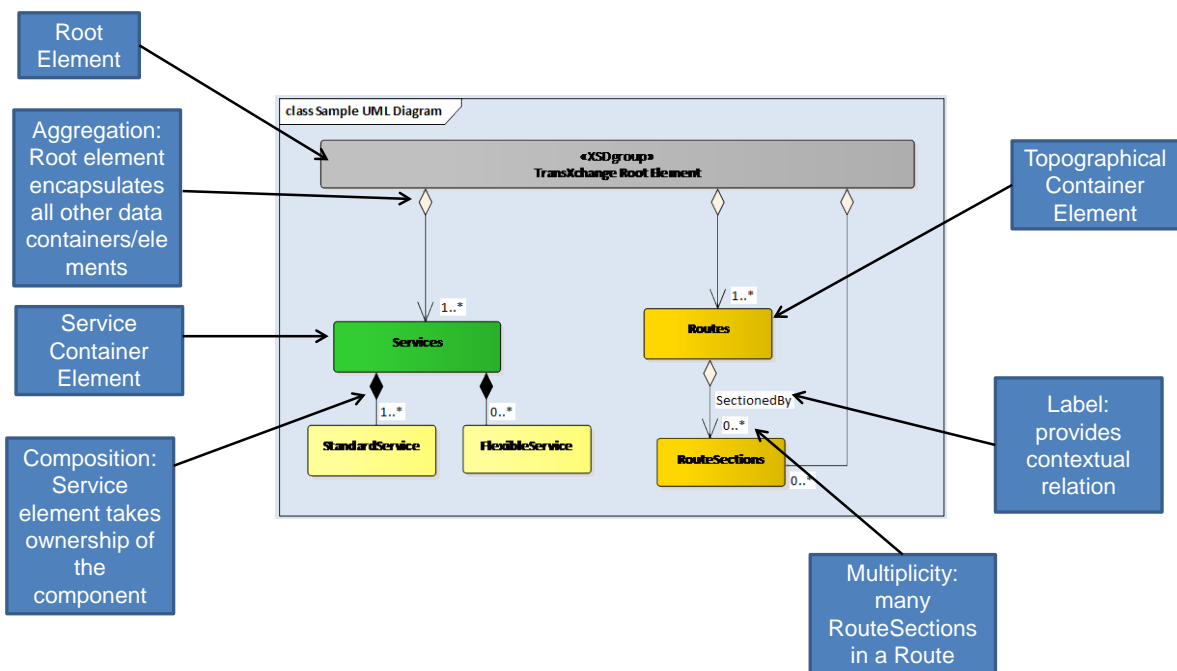


Figure 3 - UML Diagram Conventions

3.2.4 Referential Integrity

By convention, the names of attributes within an element which represent foreign keys to attributes in another element have a suffix of "Ref". For example, the **RouteSectionRef** in the *Route* element signifies that the attribute is a foreign key, i.e. its value must equal the **id** for one of the *RouteSection* elements.

3.2.5 Annotated Element Names

Where an element name has a prefix of "Annotated", this indicates that the element refers to data that is mastered externally. Examples include **AnnotatedNptgLocalityRef** and **AnnotatedStopPointRef**.

The same element name but without the Annotated prefix (e.g. **StopPointRef**) indicates that the data is defined locally, i.e. within the TransXChange document itself.

3.3 Timetable Construction

Timetables are constructed by listing the service commencement time, and subsequent transit stop times are calculated by adding the sequential link traversal times and the stop wait times on that service; this calculation differs to the TfNSW Transport Operations Data Interchange Specification (TODIS) protocol, which nominated stop times for every stop.

Each such list of times makes up a *VehicleJourney*. For example, a timetable may include a set of times for a particular sequence of stops beginning at 8:00 a.m. and another set of times for the same sequence of stops beginning at 9:00 a.m. – these are two *JourneyPatternTimingLinks* associated with the same *JourneyPattern*.

The utilisation of the standard TransXChange to PDF timetable converter, accessible on the TransXChange website, is a requirement of TfNSW, and producing informative timetables which are readily understood by a reasonable person is the standard measured against for acceptance.

3.4 Reusable Model Components

3.4.1 OperatingProfile Element

The days on which services operate are described through the *OperatingProfile* element. *OperatingDay* is a named entity that reflects the intention of the operation, such as “Weekdays” or “Public Holidays”.

These can be nested in a *Service* element, and the *VehicleJourney*. Each one represents a day type on which that service is run. A service’s valid date range is ascertained from the union of multiple *OperatingDay* entries if they exist.

If there are no operating profiles, then the vehicle journey will be defaulted to operate on every Monday through Friday, from the vehicle journey start date to the vehicle journey end date (inclusive).

3.4.2 Operational Element

TransXChange provides several means of associating different types of operational data with a timetable. For example:

- *JourneyPatterns* and *VehicleJourneys* may be associated with an *Operational* element that specifies a *VehicleType* or *TicketMachine* for a journey.
- The *Operational / VehicleType* sub-element may include basic accessibility data such as whether the vehicle is considered accessible, and some further details of the *VehicleEquipment*.
- The *Operational / Block* sub-element enables *VehicleJourney* instances to be assigned to a logical group of journeys that will be carried out by the same vehicle.

TfNSW requires journey patterns and vehicle journeys to have the *Operational* element and requires as much information as available about the accessibility features on the vehicle.

3.5 Formatting Standards

3.5.1 Durations

A *Duration* data type is used by a number of elements to specify a relative time in minutes and seconds. It uses a standard W3C duration type. The details below have been reproduced from <http://www.w3.org/TR/xmlschema-2/#duration>.

“The lexical representation for duration is the [ISO 8601] extended format *PnYn MnDTnH nMnS*, where *nY* represents the number of years, *nM* the number of months, *nD* the number of days, ‘T’ is the date/time separator, *nH* the number of hours, *nM* the number of minutes and *nS* the number of seconds. The number of seconds can include decimal digits to arbitrary precision.

For example, to indicate a duration of 1 year, 2 months, 3 days, 10 hours, and 30 minutes, one would write: P1Y2M3DT10H30M.

Reduced precision and truncated representations of this format are allowed provided they conform to the following:

- If the number of years, months, days, hours, minutes, or seconds in any expression equals zero, the number and its corresponding designator may be omitted. However, at least one number and its designator must be present.

- The seconds part may have a decimal fraction.
- The designator 'T' must be absent if and only if all of the time items are absent.
- The designator 'P' must always be present.

For example, P1347Y, P1347M and P1Y2MT2H are all allowed; P0Y1347M and P0Y1347M0D are allowed. P1Y2MT is not allowed."

4 TfNSW TransXChange Implementation Approach

The purpose of this chapter is to introduce the data elements and relationships that can be described by a TfNSW TransXChange document.

4.1 Primary Data Containers

Below is a diagram that shows the top-level containers that must be included in each TransXChange document submitted to TfNSW. The first five of these are focused on describing the network topology, whereas the remainder are used to describe the services that utilise the network.

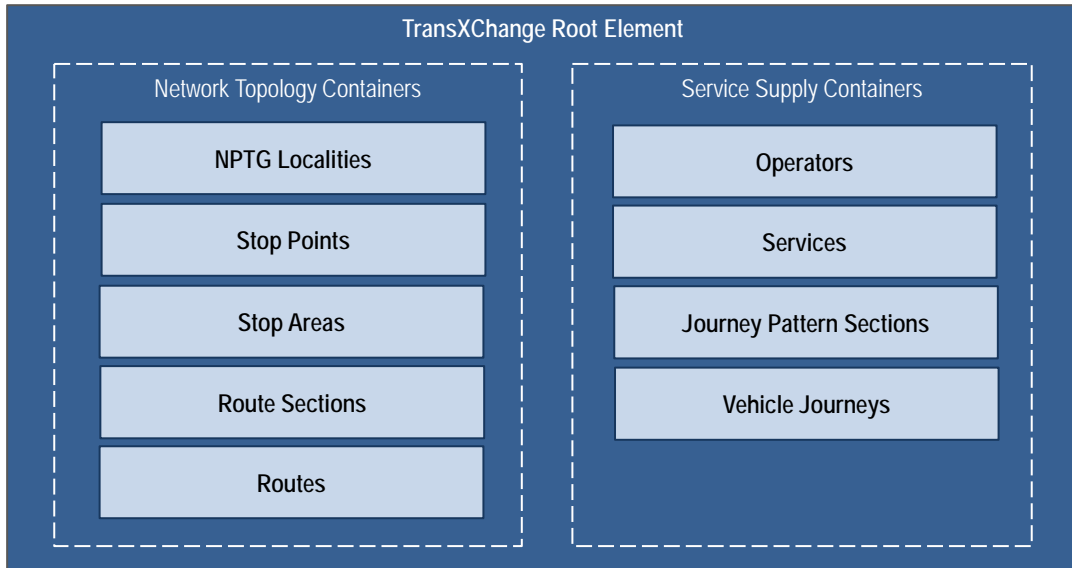


Figure 4 - Mandatory TfNSW TransXChange Data Containers

A brief description of the role of each container is provided in section 4.3. The required data elements and attributes within each container are detailed in chapter 5.

4.2 Conceptual Data Model

Below is the UML for the high level TransXChange model.

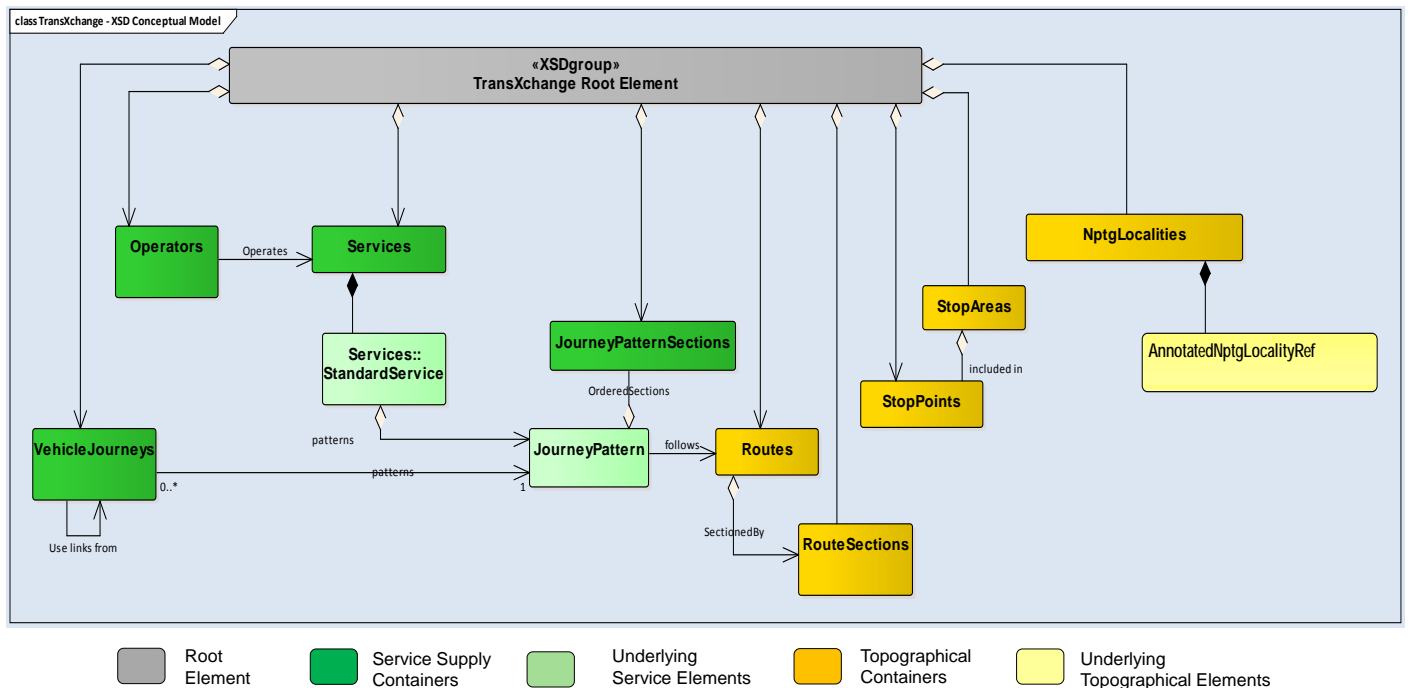


Figure 5 - High Level TransXChange Data Model

4.3 Container Descriptions

4.3.1 Localities

Localities are topographical areas that define where a stop point is relative to cities, suburbs, towns etc. They are also used to describe the regions serviced by an Operator.

In the UK TransXChange Schema Guide, localities are declared as either a ***NptgLocality*** or an ***AnnotatedNptgLocalityRef*** element, indicating that further details can be found in the National Public Transport Gazetteer (NPTG) database – a database that encompasses all UK towns and villages, as well as the regional groupings used to manage public transport data.

TfNSW has developed an equivalent database to NPTG, which is the authoritative data source for public transport regions throughout New South Wales. In the TfNSW TransXChange Schema, Operators are required to include an ***AnnotatedNPTGLocalityRef*** in their TransXChange document for each NSW region in which they operate.

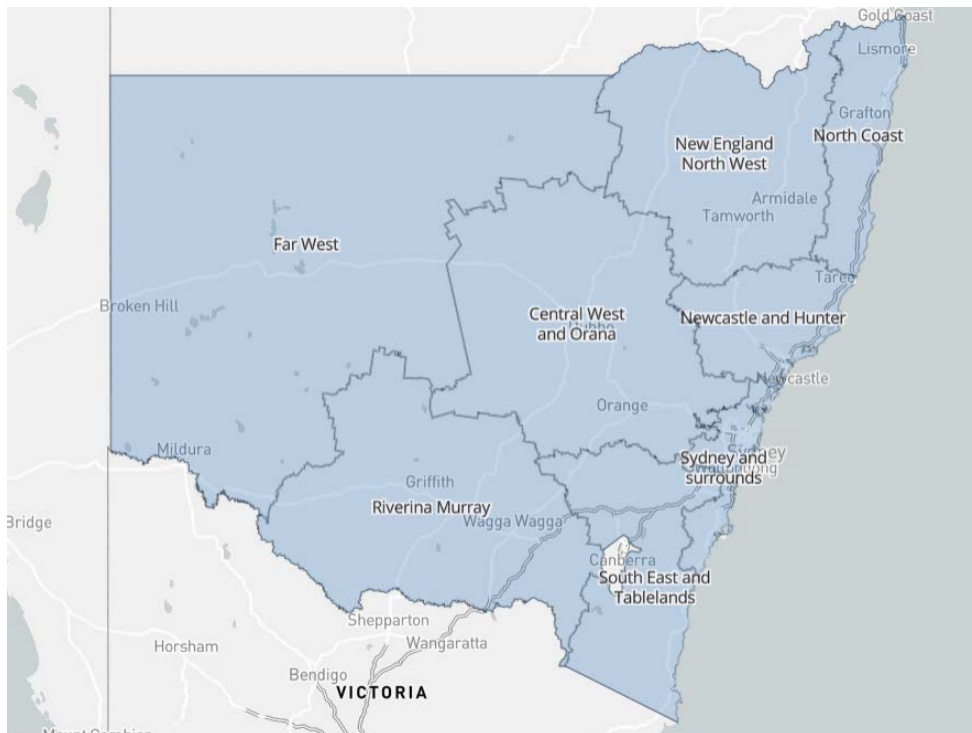


Figure 6 - Regions Currently Defined by TfNSW

Source: <https://transportnsw.info/regions#/>

4.3.2 StopPoints

Transit stops (referred to as “stop points” in the UK TransXChange schema) are the public access points to public transport and enable the public to change between routes and modes of transport. Transit stops are essential for customers to plan and to describe a public transport journey. Transit stops are frequently serviced by different operators and/or different modes of transport making it critical to apply a standard approach to describe a transit stop.

In the UK TransXChange schema, transit stops may be declared as either a ***StopPoint*** or an ***AnnotatedStopPointRef***, indicating the further details may be found in the UK National Public Transport Access Nodes (NaPTAN) database. TfNSW has developed an equivalent database to NaPTAN, known as the Transit Stop Management (TSM) application, which is the single source of information on the location, numbering, accessibility, naming and other transit stop attributes of public transport access point..

There is a TfNSW transit stop naming and numbering standard that provides a consistent and systematic way to identify individual transit stops. A unique number is assigned to each transit stop, called the Transit Stop Number (TSN). The TSN is automatically allocated by the TSM application when it is created. The TSN is made up of the post code of the suburb where the transit stop is located and the next available sequential number within that suburb e.g. 2011341, 2011342. Transit stop numbers do not change even if there is a change in the relevant postcode.

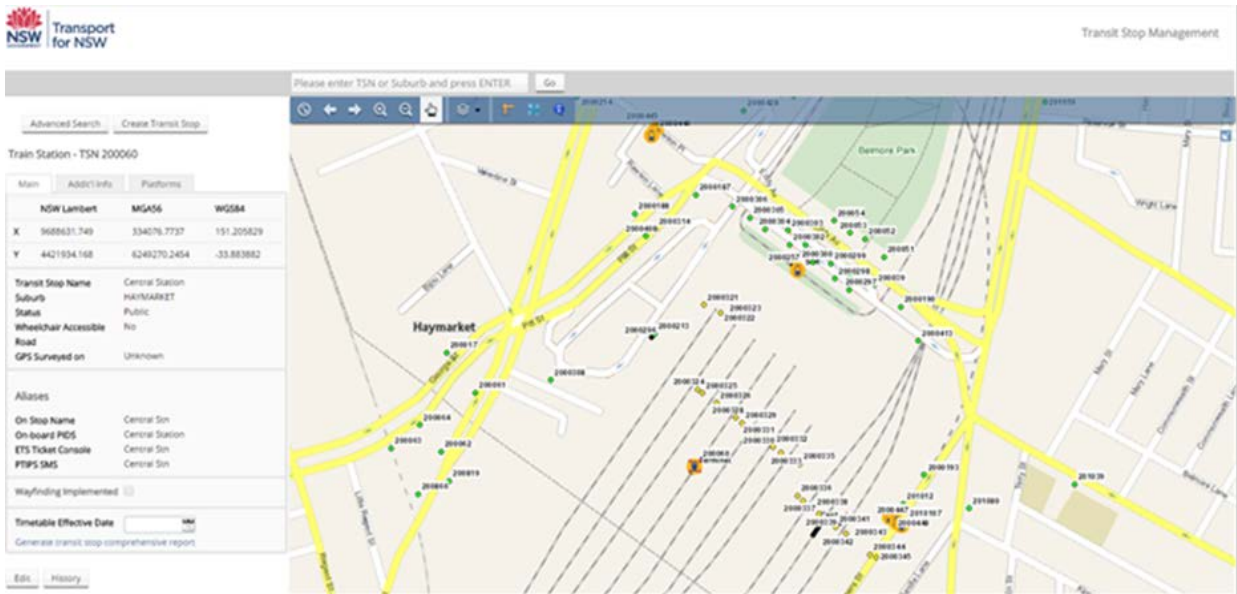


Figure 7 - Transit Stop Data Maintained by the TfNSW TSM Application

4.3.2.1 Container Decomposition

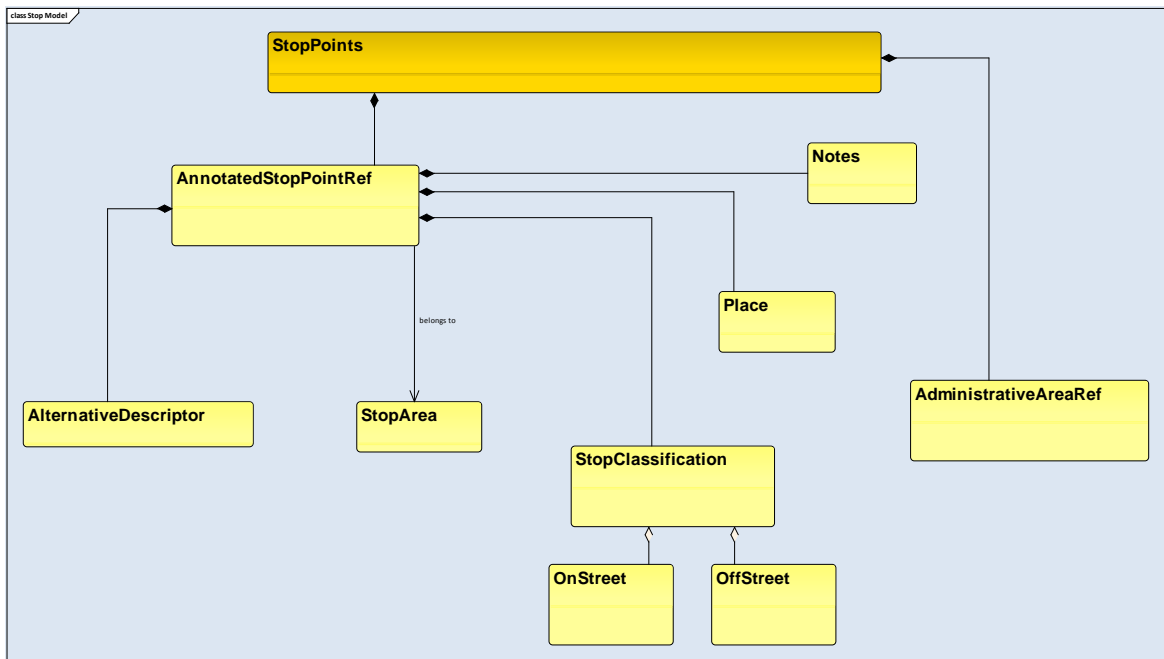


Figure 8 - TfNSW Stop Points Container Decomposition

4.3.3 StopAreas

Within TfNSW there can be a parent/child relationship between two stop points, i.e. one stop point is deemed to be a parent to another. Such examples include, but are not limited to, one stop point being an entire train station while another stop point is one of the platforms within the station. Within a TfNSW TransXChange document, the **StopArea** element is used to specify the parent for a given stop point.

In the figure below, Circular Quay - the red dot at the centre bottom of the picture – would be declared as the StopArea for each of the ferry wharves under Circular Quay (i.e. F6, F5, F4, F3, F2), the bus stops indicated by X1, X2, X3 and the train stops indicated by CCQ1 and CCQ2. Like stop points, stop areas are uniquely identified using a TfNSW transit stop number.

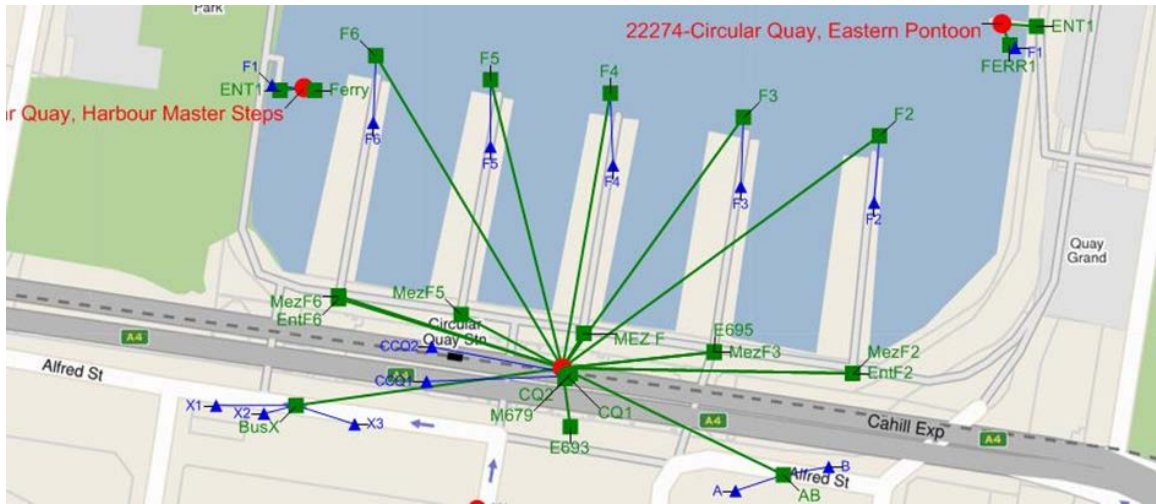


Figure 9 - Parent/Child Stop Points at Circular Quay

4.3.4 RouteSections

RouteSection elements define a portion of a **Route**. Route sections are, in turn, made up of **RouteLink** elements, which define a “from” and “to” stop point (each with a TfNSW transit stop number reference).

On each route link, the travel path of the vehicle is described using a **Track**. Track detail should be of sufficient granularity to unambiguously plot the route on an Open Street Map (as per the example below). Hence there is a TfNSW requirement to capture: each road deviation of more than 10 degrees compass bearing; roundabouts every 15 meters, at a location accuracy to 1 metre resolution.

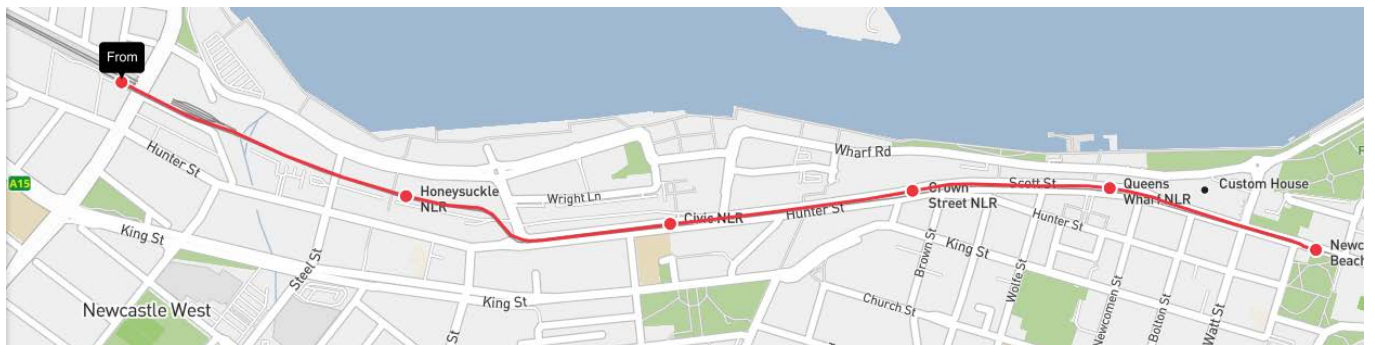


Figure 10 – Example of Transport OperatorTracks Overlaid on an Open Street Map

Track instructions may be included to guide drivers in accordance with the transport operator’s own safe operation of vehicle standards.

RouteSection elements can be re-used across variations of the Route.

4.3.4.1 Container Decomposition

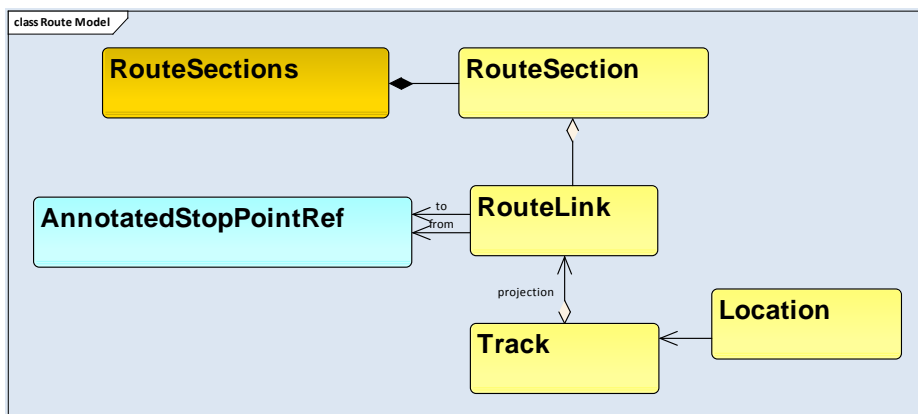


Figure 11 - TfNSW Route Sections Container Decomposition

4.3.5 Routes

The **Route** element is an operator-defined grouping of **RouteLinks** within which services are presented to the public in timetables and journey planners. There must be sufficient coverage of route link elements for the route to be unambiguously described from the start to the end point.

A Route is an internal construct to the JourneyPattern and, if reused on multiple Lines, should be provided a descriptive name such as "Route pattern from Central Station Eddy Avenue Stand 2 to Redfern reused on Lines 308, 309".

4.3.6 Operators

Each **Operator** element represents an accredited transport provider. Some of these will have TfNSW contracts; some will sub-contract to Operators with TfNSW contracts. An Operator may be, say, a bus company, or a management company set up to administer routes for a region that are shared between more than one bus company.

TfNSW requires information about each depot run by the Operator to be specified using a **Garages** sub-element. This data can subsequently be used to describe how vehicles are placed in position to deliver a service and how they are retrieved after completing the service.

4.3.6.1 Container Decomposition

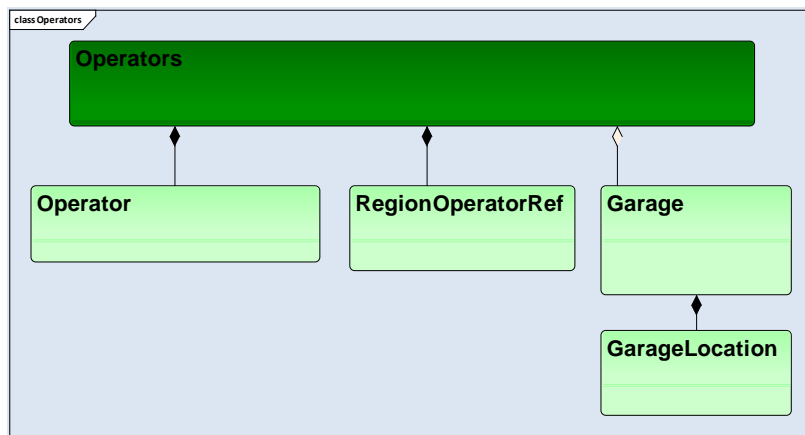


Figure 12 – TfNSW Operators Container Decomposition

4.3.7 JourneyPatternSections

A **JourneyPattern** represents the pattern of working for vehicles of the service, and is composed of an ordered collection of **JourneyPatternSection** instances, each containing an ordered collection of **JourneyPatternTimingLink** instances, together defining a specific sequence of timing links.

Journey pattern sections are reusable, i.e. the same journey pattern section may be included in many different journey patterns.

4.3.7.1 Container Decomposition

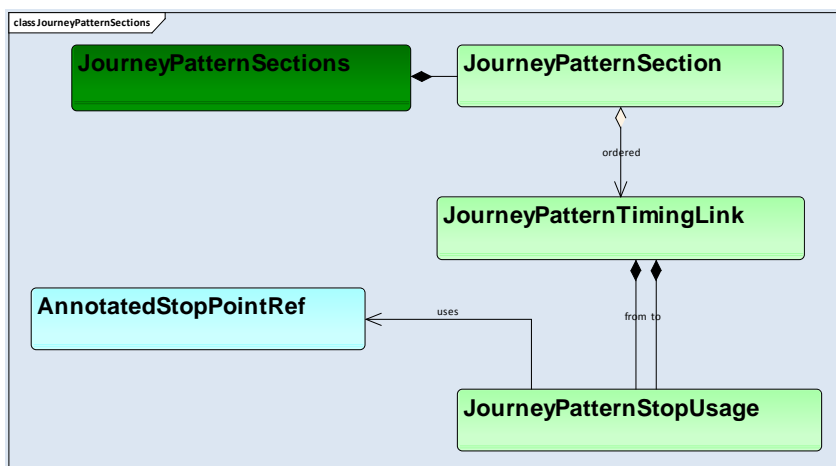


Figure 13 – TfNSW Journey Pattern Sections Container Decomposition

4.3.8 Services

A **Service** is a group of journeys that have common properties. Each service can be made up of **StandardService** and **FlexibleService** components. A standard service describes a fixed route and must include one or more journey patterns. Each service has an **OperatingPeriod**, defining its overall start and end dates, as well as an **OperatingProfile**, describing the default operational days for journeys running the service.

Service Lines

A **Line** is a group of routes which is generally known to the public by a similar name or number (as per the example below). The same line name may be used on services with different journey patterns. One or more line instances may be associated with a service.



Figure 14- Sydney Trains' Lines as at February 2019

Service Journey Patterns

A **JourneyPattern** is an ordered collection of **JourneyPatternTimingLink** elements and represents the pattern of working for vehicles of the service. Note that the order of journey pattern timing links for a journey pattern must follow the order in which they appear in the **Route** element. TransXChange vehicle journeys following a journey pattern must run over the exact route, but need not stop at all stop points identified within the journey pattern, thus the journey pattern provides the ordered set of stops of which all or some may be served by the related vehicle journeys.

4.3.8.1 Container Decomposition

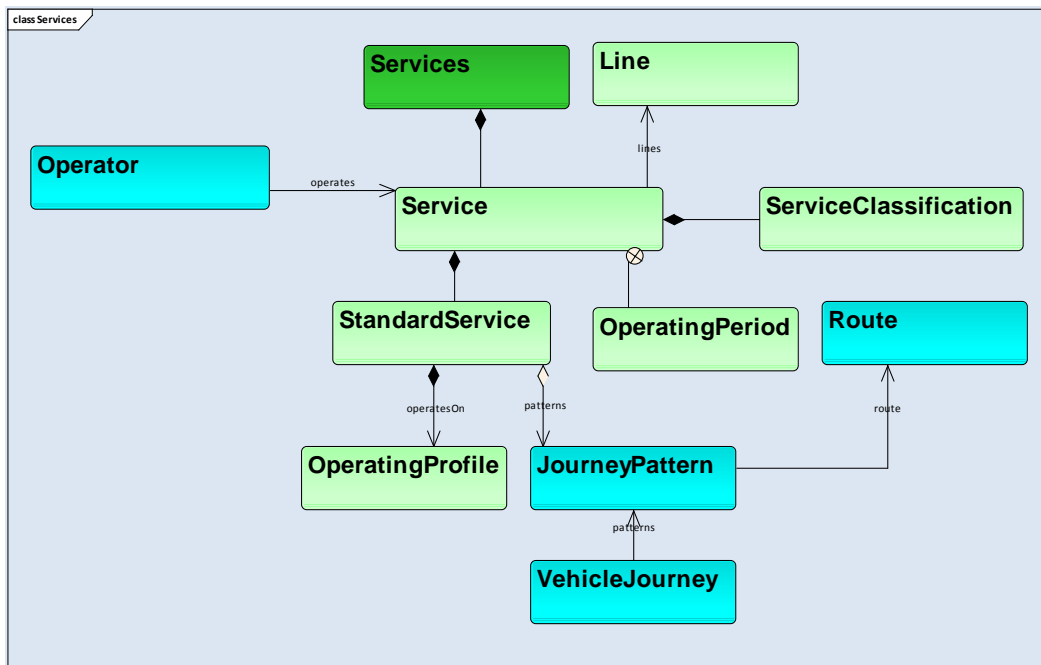


Figure 15 – TfNSW Services Container Decomposition

4.3.9 Vehicle Journeys

A **VehicleJourney** is the traversal of a series of **JourneyPatterns** at a specific time, modelled as a sequence of timing links connecting transit stops. Each vehicle journey has an absolute start time (e.g. 13:02); this can be combined with the timing information from each timing link to derive the departure and arrival time at each timing point. The link sequence for a vehicle journey must exactly correspond to the link sequence of the underlying journey pattern.

The public identifier for a vehicle journey is given by a line. Hence a vehicle journey must reference one of its service's lines. Journeys with the same Operator, line and journey pattern should be in the same service. Vehicle attributes, such as accessibility for wheelchairs and prams are stored as *VehicleFeatures*.

4.3.9.1 Container Decomposition

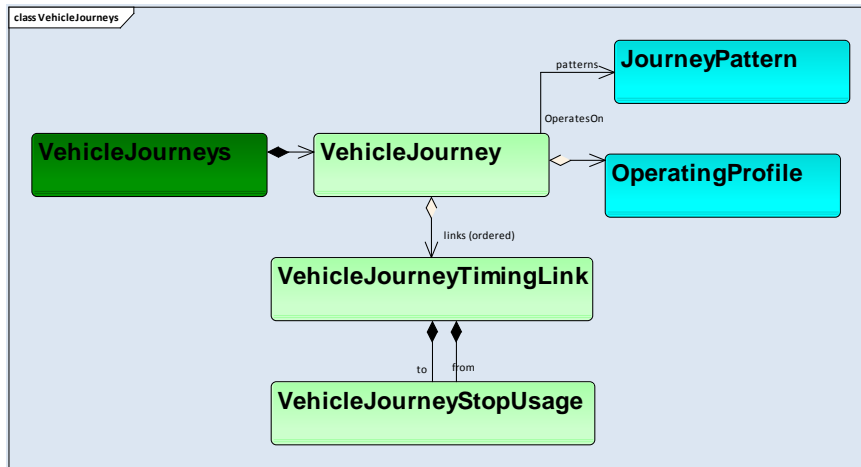


Figure 16 - TfNSW Vehicle Journeys Container Decomposition

4.4 Master Data Supplied by TfNSW

Information that is submitted to TfNSW in TransXChange format generally originates from a transport planning application, such as DIVA, HASTUS or Austrics. Some attribute values, including vehicle journey identifiers, are assigned by the Operator's transport planning application (see section 4.5). Others are pre-defined, i.e. the data is mastered by TfNSW.

The table below lists all of the TfNSW master data attributes. It is mandatory that the Operator uses the master data values supplied by TfNSW for each of these attributes when creating a TransXChange document.

Table 7 - Master Data Attributes Provided by TfNSW

TransXChange Element	TransXChange Attribute Name	Corresponding TfNSW Business Names
AnnotatedNPTGLocalityRef	<ul style="list-style-type: none"> LocalityRef LocalityName 	<ul style="list-style-type: none"> State code; Region code State name; Region name
StopArea	<ul style="list-style-type: none"> StopAreaRef Descriptor / Common Name 	<ul style="list-style-type: none"> Parent transit stop number Parent transit stop name
AnnotatedStopPointRef	<ul style="list-style-type: none"> StopPointRef Descriptor / Common Name AlternativeDescriptor / CommonName Place / LocalityRef Place / Location / Suburb Place / Location / Longitude Place / Location / Latitude NumberOfBoardingPoints WheelchairAccessible 	<ul style="list-style-type: none"> Transit stop number Transit stop name Alternative transit stop name(s) Transit stop region Transit stop suburb Transit stop longitude Transit stop latitude Number of boarding points Wheelchair accessible
Operator	<ul style="list-style-type: none"> OperatorRef OperatorCode OperatorShortName TradingName WebSite CustomerServiceTelephoneNumber LicenceNumber Garage / GarageCode Garage / GarageName Garage / Place / Location / Longitude Garage / Place / Location / Latitude 	<ul style="list-style-type: none"> Contract identifier Contract code Operator short name Trading name Web site Customer service telephone number Licence number Depot code Depot name Depot longitude Depot latitude
Service	<ul style="list-style-type: none"> Line / Line / id 	<ul style="list-style-type: none"> Line identifier

TransXChange Element	TransXChange Attribute Name	Corresponding TfNSW Business Names
	<ul style="list-style-type: none"> Line / LineName StandardService / JourneyPattern / Notes StandardService / JourneyPattern / Description StandardService / JourneyPattern / DestinationDisplay 	<ul style="list-style-type: none"> Line name Trip note Route direction Trip headsign

4.5 Operator Assigned Unique Identifiers

The TransXChange data elements listed below are identified by values assigned by data providers or their systems. Where the data value specified by the Operator in the TransXChange document can be referenced by the SIRI AVN when submitting SIRI messages, the "Used by SIRI" column contains a Yes.

Table 8 - Unique Identifiers Assigned by Operator

TransXChange Element	TransXChange Attribute Name	Used by SIRI	Comments
RouteSection	<ul style="list-style-type: none"> id 		Must be unique within the XML document
Route	<ul style="list-style-type: none"> id 		Must be unique within the XML document
JourneyPatternSection	<ul style="list-style-type: none"> id 		Must be unique within the XML document
Service	<ul style="list-style-type: none"> ServiceCode 		Must be unique within the XML document
JourneyPattern	<ul style="list-style-type: none"> id 		Must be unique within the XML document
VehicleJourney	<ul style="list-style-type: none"> id 	Yes	Must be unique within the XML document.

4.6 TransXChange Document Validation

Listed below are the primary steps involved in a successful submission of a TransXChange XML file to TfNSW.

1. Data providers register the accreditation id and Contract data with TfNSW
2. TfNSW creates a TransXChange Interface Contract for review and sign-off by the Operator
3. A TransXChange XML file, including journeypatterns and timetable, are exported from an Operator system
4. TfNSW validates the Operator's TransXChange XML file
5. TfNSW publishes the validated TransXChange XML file to authorised Data Consumers

4.6.1 Data Validation Steps

All TransXChange XML documents submitted to TfNSW will be validated as follows:

4.6.1.1 Schema Conformance Checks

Upon submission, documents will first be parsed and validated against the TfNSW TransXChange Schema Definition, including all the integrity constraints coded within the schema such as for keys, key references and TfNSW enumerations.

4.6.1.2 Additional TfNSW Data Checks

Documents must satisfy additional business rules and constraints to ensure that consumers can interpret the data correctly. Examples include:

- Operators can only utilise transit stops that exist within the TfNSW Transit Stop Management (TSM) database
- Operators can only use operator ID's issued to them by the TfNSW accreditation process
- Operators can only use contract ID's issued to them by the TfNSW procurement process
- A transit stop cannot be both "set down only" and "pick up only"
- JourneyPatternLink sequences must be non-negative, non-duplicated integers in ascending order
- A JourneyPattern must refer to at least two transit stops
- VehicleJourneyStopSequence and JourneyPatternStopSequence must yield an ordered stop sequence, starting from 1 without omission of any TSN

- The direction (inbound, outbound or circular) needs to be identical across all RouteLink elements under a Route.

4.6.2 Error Notifications

The Operator will be supplied with a comprehensive list of data validation errors and warnings following completion of XML document validations.

4.7 Other Considerations

4.7.1 Locations

The **LocationStructure** type is used to describe the spatial position of a stop or other point, for example within a **Location** element. TfNSW requires that all positional data is provided as follows:

- Longitude: WGS84 with projection 4326 Longitude from Greenwich Meridian. -180 (West) to +180 (East). Decimal degrees. e.g. 2.356. No less than 6 and no more than 7 decimal places.
- Latitude: WGS84 with projection 4326 Latitude from equator. -90 (South) to +90 (North). Decimal degrees. e.g. 56.356. No less than 6 and no more than 7 decimal places.

4.7.2 Direction

TfNSW has chosen to conform to the standard TransXChange direction enumerations. Where previously, specific localisations for TfNSW were supported in other specifications, these are to be merged to fit with the international standard. The rationale is, customisation brings expense, and creates ongoing work in assessments.

Two direction enumerations exist, at the **RouteLink** (between two transit stops), and the **ServiceDirection** levels. In the UK TransXChange schema, ServiceDirection has six possible values (outbound, inbound, inboundAndOutbound, circular, clockwise, anticlockwise). Of these, the values outbound, inbound and circular (loop) are the only ones to be utilised by New South Wales Operators.

4.7.3 Fare Support

Data providers are not required to provide fare information, this is managed internally within TfNSW and TfNSW has in place its own fare calculation and fare estimation processes which override any fare information supplied by a data provider.

5 TfNSW TransXChange Schema

This chapter details the attributes within each of the primary elements in the TfNSW TransXChange schema. When describing sub-elements, the notation “Element / Attribute” is used.

Any attributes that have been added to the UK TransXChange schema by TfNSW have a prefix of “TfNSW extension”.

Sample TfNSW values have been included for all enumerations, but please note that each list of values is indicative only and the enumerations applicable to each Operator will be detailed in the Operator’s Interface Contract.

Please note that, when a data attribute is marked as “required”, it means that an attribute value must be supplied. In other words, it is not sufficient to include the data tags but to omit a data value between them.

5.1 Root Element

5.1.1 Cardinality

Every TransXChange document has a single root element.

5.1.2 Data Attributes

Table 9 – TransXChange Root Element Attributes

Name	Data Type	Usage	Description
xml:lang	String	Mandatory	Document language, specified using the ISO language identifier. Always set to “en” (English).
CreationDateTime	DateTime	Mandatory	Date and time stamp (in ISO format) indicating when the document was created. For example, 2019-05-06T12:40:47.324+11:00.
ModificationDateTime	DateTime	Mandatory	Date and time stamp (in ISO format) indicating the latest date of change of any element within the document.
Modification	String	Mandatory	Nature of update. Sample TfNSW values include: <ul style="list-style-type: none"> • new • revise • delete
RevisionNumber	Integer	Mandatory	Sequentially increasing number assigned by the Operator.
FileName	String	Mandatory	Physical file name for the XML file containing the document. The required format for the FileName is xxxxxx_TXC_YYYYMMDDHHMMSSSS where xxxxxx is the OperatorCode.
DataSource	String	Mandatory	The name of the system that provided the data plus the current software version, e.g. DIVA14, HASTUS9.
SchemaVersion	String	Mandatory	TransXChange schema version for the document content, e.g. 2.5.
MappingSystem	String	Mandatory	Identifies the default map reference system . Always set to OSM (Open Street Maps).
LocationSystem	String	Mandatory	Data system to use for the co-ordinate references within the document. Always set to WGS84.
TfNSW extension: TimetableType	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • longTerm (i.e. 90+ days) • shortTerm (i.e. update of 1+ days to long term)
TfNSW extension: AgencyTimezone	String	Mandatory	Always set to Australia/Sydney.
TfNSW extension: xsi:schemaLocation	String	Mandatory	Location of the validation schema. https://portal.azure.com/#blade/Microsoft_Azure_Storage/FileShareMenuBlade/overview/storageAccountId/%2Fsubscriptions%2Fae44f1f6-8b48-4b2a-8187-

			2ddfbbe0315f%2FresourceGroups%2FTOS-MNP-PTM-XSD-RGP-001%2Fproviders%2FMicrosoft.Storage%2FstorageAccounts%2Fptmxsdstore/path/ptms
TfNSW extension: xmlns:xsi	String	Mandatory	http://www.w3.org/2001/XMLSchema-instance
TfNSW extension: xmlns	String	Mandatory	http://www.transxchange.org.uk/

5.2 AnnotatedNPTGLocalityRef Element

5.2.1 Cardinality

An **AnnotatedNptgLocalityRef** (with a **LocalityClassification** of “state”) is required for the state in which the timetable is applicable. An **AnnotatedNptgLocalityRef** (with a **LocalityClassification** of “region”) is also required for every TfNSW region serviced by the Operator.

5.2.2 Data Attributes

Table 10 – AnnotatedNPTGLocalityRef Attributes

Name	Data Type	Usage	Description
NptgLocalityRef	String	Mandatory	The unique identifier for the locality (as supplied by TfNSW).
LocalityName	String	Mandatory	Common text name (as supplied by TfNSW) for the locality.
LocalityClassification	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • state • region

5.3 StopArea Element

5.3.1 Cardinality

A **StopArea** element must be declared in the **StopAreas** container for each transit stop utilised by the Operator that has a parent transit stop in the TfNSW TSM database. These will be referenced when defining the Operator’s stop points.

5.3.2 Data Attributes

Table 11 – StopArea Attributes

Name	Data Type	Usage	Description
StopAreaCode	String	Mandatory	The unique identifier for the stop area (as supplied by TfNSW).
Descriptor/ CommonName	String	Mandatory	Common text name (as supplied by TfNSW) for the stop area. The name is repeated locally so that it is visible without necessarily accessing the TfNSW TSM database.

5.4 AnnotatedStopPointRef Element

5.4.1 Cardinality

An **AnnotatedStopPointRef** element must be declared in the **StopPoints** container for each transit stop defined in the TfNSW TSM database that will be used by the Operator for onboarding or offboarding customers.

These stops points will be referenced later in the document, i.e. when defining routes and journey patterns.

5.4.2 Data Attributes

Table 12 – AnnotatedStopPointRef Attributes

Name	Data Type	Usage	Description
StopPointRef	Integer	Mandatory	The unique code (as defined in TfNSW TSM database) for a Transit Stop.
Descriptor/ CommonName	String	Mandatory	Common text name (as defined in the TfNSW TSM database) for the transit stop. The name is repeated locally so that it is visible without necessarily accessing the TfNSW TSM database.
AlternativeDescriptors container (all three descriptor types must be included)			
TfNSW extension: AlternativeDescriptor / Descriptor / DescriptorType	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • onStopName • onboardPids • etsTicketConsole
AlternativeDescriptor / Descriptor / CommonName	String	Mandatory	The display name for the descriptor type (as defined in the TfNSW TSM database).
TfNSW extension: PlatformCode	String	Mandatory where the stop is a platform	
TfNSW extension: PublicUse	Boolean	Mandatory	Indicates whether the stop is open to the general public or is restricted to specific groups, i.e. 'closed door'.
TfNSW extension: StopHeadsign	String	Mandatory	
TfNSW extension: NumberOfBoardingPoints	Positive integer	Mandatory	
TfNSW extension: WheelchairBoarding	Boolean	Mandatory	Indicates whether wheelchair boarding is permitted.
StopAreas container (required if a parent TSN has been specified for the transit stop in the TSM database)			
StopAreaRef	FK:StopArea	If applicable	The parent transit stop number for the stop point (as defined in the TfNSW TSM database).
Place group (mandatory)			
Place / LocalityRef	FK:AnnotatedNpt gLocalityRef	Mandatory	The region in which the stop is located (as defined in the TfNSW TSM database).
Place / Suburb	String	Mandatory	Common text name (as defined in the TfNSW TSM database) for the suburb in which the transit stop is located. The name is repeated locally so that it is visible without necessarily accessing the TfNSW TSM database.
Place / Location / Latitude	Float	Mandatory	Stop latitude (as defined in the TfNSW TSM database). Minimum of 6 and a maximum of 7 decimal places.
Place / Location / Longitude	Float	Mandatory	Stop longitude (as defined in the TfNSW TSM database). Minimum of 6 and a maximum of 7 decimal places.
StopClassification group (mandatory)			
StopClassification / StopType	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • busCoachTramStopOnStreet • busCoachTramStationBay • busCoachTramStationVariableBay • busCoachAccess • busCoachStationEntrance • busCoachPrivate • railPlatform • railAccess • railStationEntrance • tramMetroOrUndergroundPlatform

Name	Data Type	Usage	Description
			<ul style="list-style-type: none"> tramMetroOrUndergroundAccess tramMetroOrUndergroundEntrance ferryOrPortAccess ferryTerminalDockEntrance liftOrCableCarPlatform liftOrCableCarAccessArea liftOrCableCarStationEntrance taxiRank sharedTaxiRank setDownArea airportEntrance
StopClassification / OnStreet / Bus / BusStopType	String	Mandatory for on-street stops	Sample TfNSW values include: <ul style="list-style-type: none"> hailAndRide flexible marked custom
StopClassification / OnStreet / Bus / MarkedPoint / Bearing / CompassPoint	String	Mandatory for on-street stops	Absolute bearing, i.e. compass direction of a bus along a street. Sample TfNSW values include: <ul style="list-style-type: none"> north northWes west southWest south southEast east northEast
TfNSW extension: Notes container (To be included if notes will assist customers, drivers etc.)			
NoteCode	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> customerNote driverNote operatorNote
NoteText	String	Mandatory	Text of note. For example: "Gates at wharf close 2 mins before service departs".
Private	Boolean	Mandatory	Indicates whether the note will or will not be sent to public-facing channels.

5.5 RouteSection Element

5.5.1 Data Attributes

The number of *RouteSection* elements declared in the XML document will be determined by each Operator. A *RouteSection* element can be reused across more than one Route.

5.5.2 Data Attributes

Table 13 – RouteSection Attributes

Name	Data Type	Usage	Description
id	String	Mandatory	A unique identifier within the file, to be referenced by the <i>JourneyPatternSection</i> and <i>Route</i> elements.
Description	String	Mandatory	A description for this section of the route.
RouteLinks container (The number of route links will be determined by the Operator)			
RouteLink / id	String	Mandatory	The identifier for this route link. This will subsequently be referenced by other elements within this file as RouteLinkRef.
RouteLink / From /	FK:AnnotatedStop	Mandatory	The transit stop this link runs from.

StopPointRef	PointRef		
RouteLink / To / StopPointRef	FK:AnnotatedStopPointRef	Mandatory	The transit stop this link ends at.
RouteLink / Direction	String	Mandatory	The direction needs to be common across the complete list of route link elements under a route. Sample TfNSW values include : <ul style="list-style-type: none"> • inbound, • outbound • circular. Circular is used to denote TfNSW-commonly named 'loop' services.
RouteLink / Track / Instructions	String	Optional	Driving instructions to the next location on the track. This is usually about landmarks and what direction to head at that landmark, e.g. "Go straight ahead at the junction". If the line is straight, the norm is for no Instructions to be provided.
RouteLink / Track / Mapping / Location / Longitude	Float	Mandatory	Longitude, to a minimum of 6 and a maximum of 7 decimal places.
RouteLink / Track / Mapping / Location / Latitude	Float	Mandatory	Latitude, to a minimum of 6 and a maximum of 7 decimal places.

5.6 Route Element

A collection of *RouteSections*. Service paths and stopping patterns are grouped within *Routes*.

5.6.1 Data Attributes

Table 14 – Route Attributes

Name	Data Type	Usage	Description
id	String	Mandatory	A unique identifier for this route.
Description	String	Mandatory	The descriptive name for the route, e.g. Westfield Hurstville_Cross Street – Riverwood Station; Newcastle Beach – Newcastle Interchange; Darling Harbour Wharf – Manly Wharf
RouteSections container			
RouteSectionRef	FK:RouteSection	Mandatory	The unique identifier for the RouteSection.

5.7 Operator Element

5.7.1 Cardinality

Each incoming TransXChange data set will pertain to a single Operator, i.e. it will contain just 1 Operator Element.

5.7.2 Data Attributes

Table 15 – Operator Attributes

Name	Data Type	Usage	Description
OperatorRef	Integer	Mandatory	The unique identifier for each Operator. Contains the TfNSW supplied contract identifier (e.g. 2435). TfNSW will assign an ID for non-contract Operators.
OperatorCode	String	Mandatory	TfNSW supplied Contract Code (e.g. OSMBSC001). TfNSW will assign a code for non-contract Operators.
OperatorNames group (mandatory)			

Name	Data Type	Usage	Description
OperatorNames / OperatorShortName	String	Mandatory	The Provider Reference for the Operator, as supplied by TfNSW, e.g. NT.
OperatorNames / OperatorNameOnLicence	String	Mandatory	Full name of the Operator (as it appears on the licence).
OperatorNames / TradingName	String	Mandatory	Name of the PTY company. Supplied by TfNSW.
OperatorLicence group (mandatory)			
OperatorLicence / LicenceNumber	String	Mandatory	Provided by TfNSW.
OperatorLicence / LicenceClassification	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • standardNational • standardInternational • restricted • specialRestricted • communityBusPermit
OperatorLicenc / LicenceExpiryDate	Date	Mandatory if supplied to the Operator	
OperatorLicence / LicenceHolderNames container (each individual named on the Operator's licence must be included)			
LicenceHolderName	String	Mandatory	The name of the licence holders.
OperatorParent group (mandatory if the Operator is subcontracted by another Operator to provide services)			
OperatorParent / ParentOperatorRef	FK:Operator	Mandatory if the Operator is subcontracted by another operator to provide services.	The TfNSW supplied contract identifier for the immediate parent.
OperatorInfo group (mandatory)			
PrimaryMode	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • bus • coach • ferry • metro • rail • tram
RegionRef	FK:AnnotatedLocalityRef	Mandatory	Always set to the state in which the Operator is licenced, e.g. NSW.
RegionOperatorRefs container (each region serviced by the Operator must be included)			
RegionOperatorRef / RegionRef	FK:AnnotatedLocalityRef	Mandatory	The unique identifier for the region (as supplied by TfNSW)..
OperatorContact group			
OperatorContact / ContactTelephoneNumber / TelNationalNumber	Integer	Mandatory	The contact number, including area code, for data-related queries, not customer (public) contact. Must be 10 digits in length.
OperatorContact / ContactTelephoneNumber / TelCountryCode	String	Mandatory	Always set to +61.
OperatorContact / ContactPerson	String	Mandatory	The contact person for data-related queries, not customer (public) contact

Name	Data Type	Usage	Description
OperatorContact / CustomerServiceTelephone Number / TelNationalNumber	Integer	Mandatory	The contact number, including area code, for customer (public) contact (e.g. Lost Property). Must be 10 digits in length.
OperatorContact / CustomerServiceTelephone Number / TelCountryCode	String	Mandatory	Always set to +61
OperatorAddresses container (mandatory)			
OperatorAddress	-	Mandatory	The operator physical address for headoffice / main point of contact. Must be a recognised address point.
OperatorAddress / Line1	String	Mandatory	Minimum of 5 and maximum of 35 characters.
OperatorAddress / Line2	String	Mandatory	Minimum of 5 and maximum of 35 characters.
OperatorAddress / Line3	String	Optional	Minimum of 5 and maximum of 35 characters.
OperatorAddress / Line4	String	Optional	Minimum of 5 and maximum of 35 characters.
OperatorAddress / Line5	String	Optional	Minimum of 5 and maximum of 35 characters.
EmailAddress			
EmailAddress	String	Mandatory	The email address for data-related queries, not customer (public) contact
WebSite	String	Mandatory	The website URL for customer-related queries
AccessibilityBookings group (mandatory)			
AccessibilityBookings / AssistanceAvailability	String	Mandatory	Availability of services for wheelchair users. Sample TfNSW values include: <ul style="list-style-type: none"> • none • available • availableIfBooked • availableAtCertainTimes.
AccessibilityBookings / WheelchairBookingRequired	Boolean	Mandatory	Indicates whether wheelchair booking is required.
AccessibilityBookings / BookingContact group (mandatory)			
AccessibilityBookings / BookingContact / ContactTelephoneNumber / TelNationalNumber	Integer	Mandatory	Contact telephone number, including area code, for accessibility bookings. Must be 10 digits in length.
AccessibilityBookings / BookingContact / ContactTelephoneNumber / TelCountryCode	String	Mandatory	Always set to +61.
AccessibilityBookings / BookingContact / EmailAddress	String	Mandatory	The email address for accessibility bookings.
AccessibilityBookings / BookingArrangements group (mandatory)			
AccessibilityBookings / BookingArrangements / BookingMethod	String	Mandatory	Booking methods allowed. Sample TfNSW values include: <ul style="list-style-type: none"> • online • callDriver • callOffice • phonesAtStop • text • none.
AccessibilityBookings / BookingArrangements / BookingInterval	Duration	Mandatory	Minimum interval in advance of departure day or time that service may be ordered.

Name	Data Type	Usage	Description
Minimum BookingPeriod			Required TfNSW format is PnDTnHnM.
AccessibilityBookings / BookingArrangements / LatestBookingTime	Time (in hh:mm format)	Mandatory	Latest time in the day that a booking can be made.
AccessibilityBookings / BookingArrangements / BookingUrl	String	Mandatory	The web site address for accessibility information and/or booking.
AccessibilityBookings / BookingArrangements / Note	String	Optional	Additional note on booking arrangements.
Garages container (each of the Operator's depots must be included)			
Garage / GarageCode	String	Mandatory	The unique identifier for the depot, as supplied by TfNSW.
Garage / GarageName	String	Mandatory	The description for the depot, as supplied by TfNSW. For example "Terrey Hills" or "Brookvale".
Garage / ContactNumber	String	Mandatory	
Garage / Address / Line1	String	Mandatory	Minimum of 5 and maximum of 35 characters.
Garage / Address / Line2	String	Mandatory	Minimum of 5 and maximum of 35 characters.
Garage / Address / Line3	String	Optional	Minimum of 5 and maximum of 35 characters.
Garage / Address / Line4	String	Optional	Minimum of 5 and maximum of 35 characters.
Garage / Address / Line5	String	Optional	Minimum of 5 and maximum of 35 characters.
Garage / Location / Latitude	Float	Mandatory	Latitude (with a minimum of 6 and maximum of 7 decimal places)
Garage / Location / Longitude	Float	Mandatory	Longitude (with a minimum of 6 and maximum of 7 decimal places)

5.8 JourneyPatternSection Element

Journey Pattern Section elements encapsulate the expected durations across links for a Route. The Journey Pattern Section elements are used subsequently in StandardService and VehicleJourney elements to describe the time taken to traverse their links, allowing for different times of day to take longer durations etc.

5.8.1 Data Attributes

Table 16 – JourneyPatternSection Attributes

Name	Data Type	Usage	Documentation
id	String	Mandatory	A unique identifier for the journey pattern within the TransXChange document, to be referenced by <i>Service</i> elements.
JourneyPatternTimingLinks container			
JourneyPatternTimingLink / id	String	Mandatory	A unique identifier for the journey pattern timing link. The same journey pattern timing link can be re-used in multiple journey pattern sections.
JourneyPatternTimingLink / From group (mandatory)			
JourneyPatternTimingLink / From / SequenceNumber	Positive integer	Mandatory	The number in which this link appears in the ordered list of links through the Route.
JourneyPatternTimingLink /	String	Mandatory	Sample TfNSW values include:

Name	Data Type	Usage	Documentation
From / JourneyPatternStopUsage / Activity			<ul style="list-style-type: none"> pickup pickUpAndSetDown setDownOnly hailAndRideStart (if this is the commencement of a hail and ride section)
JourneyPatternTimingLink / From / JourneyPatternStopUsage / WaitTime	Duration	Mandatory	<p>The planned wait time at the stop point. Used to calculate departure times.</p> <p>Required format is PT, followed by the time in xHyMzS format, meaning x hours, y Minutes, and z seconds. Eg. PT0H1M0S = 1 minute</p>
JourneyPatternTimingLink / From / StopPointRef	FK:AnnotatedStopPointRef	Mandatory	Reference to a previously-defined stop point, e.g.2300129.
JourneyPatternTimingLink / From / TimingStatus	String	Mandatory	<p>The timing status of each stop. Valid values are:</p> <ul style="list-style-type: none"> principalTimingPoint timeInfoPoint otherPoint <p>For every stop where the customer can access the vehicle, the TimingStatus must be principalTimingPoint or timeInfoPoint..</p> <p>The principal timing points will appear in the timetable.</p>
JourneyPatternTimingLink / To group (mandatory)			
JourneyPatternTimingLink / To SequenceNumber	Positive integer	Mandatory	The number in which this link appears in the ordered list of links through the Route.
JourneyPatternTimingLink / To / Activity	String	Mandatory	<p>Sample TfNSW values include:</p> <ul style="list-style-type: none"> pickup pickUpAndSetDown SetDownOnly hailAndRideEnd (if this is the end of a hail and ride section)
JourneyPatternTimingLink / To / StopPointRef	FK:AnnotatedStopPointRef	Mandatory	Reference to a previously-defined stop point, e.g.2300128. The "to" stop point reference must not be the same as the "from" stop point reference.
JourneyPatternTimingLink / To / TimingStatus	String	Mandatory	<p>The timing status of each stop. Valid values are:</p> <ul style="list-style-type: none"> principalTimingPoint timeInfoPoint otherPoint. <p>For every stop where the customer can access the vehicle, the TimingStatus must be principalTimingPoint or timeInfoPoint..</p> <p>The principal timing points will appear in the timetable.</p>
JourneyPatternTimingLink / To / JourneyPatternStopUsage / WaitTime	Duration	Mandatory	<p>The planned wait time for the stop point. Used to calculate departure times.</p> <p>Required format is PT, followed by the time in xHyMzS format, meaning x hours, y Minutes, and z seconds. Eg. PT0H1M0S = 1 minute</p>
JourneyPatternTimingLink / To / JourneyPatternStopUsage / SequenceNumber	Positive integer	Mandatory	The SequenceNumber attribute is specified to suggest a preferred sort order of stops for presentation.
RouteLinkRef	FK:RouteLink	Mandatory	The route link that this timing link projects onto.
RunTime	Duration	Mandatory	<p>The time taken to traverse a timing link.</p> <p>Required format is PT, followed by the time for in xHyMzS format, meaning x hours, y Minutes, and z seconds. Eg. PT0H5M30S = 5 minutes and 30 seconds</p>

5.9 Service Element

5.9.1 Data Attributes

Table 17 – Service Attributes

Name	DataType	Usage	Documentation
ServiceCode	String	Mandatory	The unique identifier for a service.
Lines container (mandatory)			
Line / id	String	Mandatory	The unique identifier for the line, as supplied by TfNSW.
Line / LineName	String	Mandatory	The name of the line, as supplied by TfNSW e.g. Bondi Beach to Circular Quay return. Maximum length is 50 characters.
Line / LineColour group (mandatory)			
Line / LineColour / LineColour	String	Mandatory	Hexadecimal colour code (e.g. 00B5EF) for displaying the line on graphics media. Minimum and maximum length is 6 characters.
Line / LineColour / LineFontColour	String	Mandatory	Hexadecimal colour code (e.g. FFFFFFF) for presenting any text for line. Maximum length is 6 characters.
OperatingPeriod element (mandatory)			
OperatingPeriod / StartDate	Date	Mandatory	Inclusive start date of the validity period. Required format is YYYY-MM-DD.
OperatingPeriod / EndDate	Date	Mandatory	Inclusive end date of the validity period. Required format is YYYY-MM-DD.
OperatingProfile group (mandatory)			
OperatingProfile / RegularDayType / DaysOfWeek	String	Mandatory	Days on which the service regularly runs.
ServiceClassification element (mandatory to provide at least 1 classification)			
ServiceClassification	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • normalStopping • limitedStops • hailAndRide • flexible • excursionOrTour • schoolOrWorks • ruralService • otherService
TfNSW extension: ServiceTypeCode	String	Mandatory	Equates to the The GTFS route_ type, e.g. 712.
TfNSW extension: ServiceTypeDescription	String	Mandatory	Equates to the The GTFS route_desc, e.g. School bus service.
ServiceOperational group (mandatory)			
ServiceOperational / VehicleType element (mandatory)			
ServiceOperational / VehicleType / VehicleTypeCode	String	Optional	Code that classifies the vehicle.
ServiceOperational / VehicleType / Description	String	Optional	Free text description of vehicle type.
TfNSW extension:	Boolean	Manadatory	Indicates whether bicycles are permitted inside the

Name	Data Type	Usage	Documentation
ServiceOperational / VehicleType / BikesAllowed			vehicle.
ServiceOperational / VehicleType / VehiclePassengerInfoEquipment / PassengerInfoEquipment / PassengerInfo	String	Mandatory	As present in the planned vehicle. Sample TfNSW values include: <ul style="list-style-type: none"> • nextStopIndicator • stopAnnouncements • passengerInformationFacility
ServiceOperational / VehicleType / VehiclePassengerInfoEquipment / PassengerInfoEquipment / AccessibilityInfo	String	Mandatory	As present in the planned vehicle. Sample TfNSW values include: <ul style="list-style-type: none"> • audioInformation • audioForHearingImpaired • visualDisplays • DisplaysForVisuallyImpaired • tactilePlatformEdges • tactileGuidingStrips • largePrintTimetables
ServiceOperational / VehicleType / VehiclePassengerInfoEquipment / WheelchairEquipment / NumberOfWheelchairAreas	Integer	Mandatory	If number of wheelchair areas is one or more, the service is deemed to be wheelchair-accessible.
ServiceOperational / VehicleType / VehiclePassengerInfoEquipment / AccessVehicleEquipment / LowFloor	Boolean	Mandatory	
ServiceOperational / VehicleType / VehiclePassengerInfoEquipment / AccessVehicleEquipment / Ramp	Boolean	Mandatory	
ServiceOperational / VehicleType / VehiclePassengerInfoEquipment / AccessVehicleEquipment / AssistanceNeeded	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • levelAccess • rampRequired • hoistRequired • assistanceRequired
ServiceOperational / VehicleType / VehiclePassengerInfoEquipment / AccessVehicleEquipment / AssistedBoardingLocation	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • boardAtAnyDoor • boardOnlyAtSpecifiedPositions • unknown
RegisteredOperatorRef			
RegisteredOperatorRef	FK:Operator	Mandatory	The registered operator for the service. Must reference the Operator element defined earlier in the TransXChange document.
ServiceInfo group (mandatory)			
ServiceInfo / Mode	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • bus • coach • ferry • metro • rail • tram
ServiceInfo / PublicUse	Boolean	Mandatory	Indicates whether the service is open to the general public or is restricted to specific groups, i.e. 'closed door'.
ServiceInfo / Express	Boolean	Mandatory	Indicates whether the service is an express route.
ServiceDescription group (mandatory)			

Name	Data Type	Usage	Documentation
ServiceDescription / Description	String	Mandatory	
ServiceComponent group (mandatory)			
<i>ServiceComponent / StandardService element</i>			
StandardService / Origin	String	Mandatory	Public name of the place where the service starts.
StandardService / Destination	String	Mandatory	Public name of the place where the service ends
StandardService / JourneyPatterns container			
StandardService / JourneyPattern / id	String	Mandatory	The unique identifier for the journey pattern. Assigned by the Operator.
StandardService / JourneyPattern / DestinationDisplay	String	Mandatory	Journey destination, as displayed on the vehicle., e.g. Wynyard. Maximum length is 20 characters.
StandardService / JourneyPattern / Description	String	Mandatory	The line direction name, e.g. Newcastle Beach to Newcastle Interchange Maximum length is 50 characters.
StandardService / JourneyPattern / RouteRef	FK:Route	Mandatory	
StandardService / JourneyPattern / JourneyPatternSectionRefs container			
StandardService / JourneyPattern / JourneyPatternSectionRefs / JourneyPatternSectionRef	FK:JourneyPatternSection	A minimum of one is mandatory.	The sections making up the journey pattern, in order of traversal.
ServiceComponent / Direction			
ServiceComponent / Direction	String	Mandatory	The direction of the service. Sample TfNSW values include: <ul style="list-style-type: none"> inbound outbound circular
StopRequirements	String	Optional	Always set to "NoNewStopsRequired".

5.10 VehicleJourney Element

Each VehicleJourney element represents a single timed traversal of a route on a specified operating day profile. The durations for traversal between timing points use JourneyPatternTimingLinks defined in the Route model.

5.10.1 Data Attributes

Table 18 – VehicleJourney Attributes

Name	Data Type	Usage	Documentation
id	String	Mandatory	The unique identifier the vehicle journey. This is assigned by the Operator and must be unique within the TransXChange document.
Operational group			
<i>Operational / VehicleType element (mandatory if vehicle type attributes differ from that specified at the service level)</i>			
Operational / VehicleType / VehicleTypeCode	String	Optional	Code that classifies the vehicle.
Operational / VehicleType / Description	String	Optional	Free text description of vehicle type.
TfNSW extension: Operational / VehicleType / BikesAllowed	Boolean	Mandatory	Indicates whether bicycles are permitted inside the vehicle.

Name	Data Type	Usage	Documentation
Operational / VehicleType / VehiclePassengerInfoEquipment / PassengerInfoEquipment / PassengerInfo	String	Mandatory	As present in the planned vehicle. Sample TfNSW values include: <ul style="list-style-type: none"> • nextStopIndicator • stopAnnouncements • passengerInformationFacility
Operational / VehicleType / VehiclePassengerInfoEquipment / PassengerInfoEquipment / AccessibilityInfo	String	Mandatory	As present in the planned vehicle. Sample TfNSW values include: <ul style="list-style-type: none"> • audioInformation • audioForHearingImpaired • visualDisplays • DisplaysForVisuallyImpaired • tactilePlatformEdges • tactileGuidingStrips • largePrintTimetables
Operational / VehicleType / VehiclePassengerInfoEquipment / WheelchairEquipment / NumberOfWheelchairAreas	Integer	Mandatory	If number of wheelchair areas is one or more, the service is deemed to be wheelchair-accessible.
Operational / VehicleType / VehiclePassengerInfoEquipment / AccessVehicleEquipment / LowFloor	Boolean	Mandatory	
Operational / VehicleType / VehiclePassengerInfoEquipment / AccessVehicleEquipment / Ramp	Boolean	Mandatory	
Operational / VehicleType / VehiclePassengerInfoEquipment / AccessVehicleEquipment / AssistanceNeeded	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • levelAccess • rampRequired • hoistRequired • assistanceRequired
Operational / VehicleType / VehiclePassengerInfoEquipment / AccessVehicleEquipment / AssistedBoardingLocation	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> • boardAtAnyDoor • boardOnlyAtSpecifiedPositions • unknown
Operational / Block element			
Operational / Block / BlockNumber	Positive integer	If needed	The reference number for the block.
OperatingProfile group			
OperatingProfile / RegularDayType / DaysOfWeek	String	Mandatory	Defines for this vehicle journey, the daily pattern on which it will be repeated. Sample TfNSW values include: <ul style="list-style-type: none"> • monday • tuesday • wednesday • thursday • friday • saturday • Sunday • mondayToSunday • mondayTo Saturday • mondayToFriday • weekend • notMonday • notTuesday • notWednesday • notThursday • notFriday

Name	Data Type	Usage	Documentation
			<ul style="list-style-type: none"> notSaturday notSunday
OperatingProfile / SpecialDaysOperation / DaysOfOperation / DateRange / StartDate	Date	Mandatory if there are any special days of operation	The start date when the service will operate differently from its normal service.
OperatingProfile / SpecialDaysOperation / DaysOfOperation / DateRange / EndDate	Date	Mandatory if there are any special days of operation	The end date when the service will operate differently from its normal service.
OperatingProfile / SpecialDaysOperation / DaysOfNonOperation / DateRange / StartDate	Date	Mandatory if there are any special days of non-operation	The start date when the service will not operate, i.e. will depart from its normal service.
OperatingProfile / SpecialDaysOperation / DaysOfNonOperation / DateRange / EndDate	Date	Mandatory if there are any special days of non-operation	The end date when the service will not operate, i.e. will depart from its normal service.
ServiceRef	FK:Service	Mandatory	The service which is delivered by this vehicle journey
LineRef	FK:Line	Mandatory	The line this vehicle journey will service.
JourneyPatternRef	FK:JourneyPattern	Mandatory	The reference for the JourneyPattern which is planned to be traversed during the Vehicle Journey.
DepartureTime	Time	Mandatory	The departure time (as a specific clock hour in Sydney time) from the first stop in the journey pattern. For example: 10:00, 18:30.
DepartureDayShift	Integer	Mandatory	Indicates whether the departuretime is to be shown as the same day (0), the next day (+1) or the previous day (-1).
VehicleJourneyTimingLinkRef	FK:VehicleJourneyTimingLink	If needed	Specifying one or more VehicleJourneyTimingLink Ids for the vehicle journey allows specific timings to affect the timetable for this exact VehicleJourneyId. The timings override those defined at the ServiceRef and JourneyRef abstraction levels. If specified, the overriding timing link between the sequence numbers From and To, inclusive.
VehicleJourneyStopUsage	Txc: VehicleJourneyStopUsage	If Needed	TfNSW requires the timetable to be accurate to the second. In order to articulate the wait (dwell) time at a stop along the vehicle journey, should the timing be required, the specific values for the VehicleJourney are required.
VehicleJourneyStopSequence	Positive integer	If needed	The SequenceNumber attribute is specified to suggest a preferred sort order of stops for presentation.
Notes container (To be included if notes will assist customers, drivers etc.)			
NoteCode	String	Mandatory	Sample TfNSW values include: <ul style="list-style-type: none"> customerNote driverNote operatorNote
NoteText	String	Mandatory	Text of note. For example: "Gates at wharf close 2 mins before service departs".
Private	Boolean	Mandatory	Indicates whether the note will or will not be sent to public-facing channels.

6 TfNSW TransXChange Use Cases

6.1 Business Scenarios Quick Reference

The quick reference table provides a list of most commonly occurring scenarios that must be supported by TransXChange. In the following sections a full description of how to use TransXChange for each scenario is provided for interested data suppliers and consumers.

Table 19 – TransXChange Use Case Overview

Business Use Case No.	Business Use Case Name	Short Description	Note
UC-1	Base (Long Term) Timetable establishment	A base timetable with a minimum of 90 days projection of scheduled timetable data is submitted by an Operator	-
UC-2	Base (LongTerm) Timetable periodic refresh	Base timetable must be maintained with rolling 90 days forward planning for journey planner tools by submitting a weekly refresh of base/long term timetable	-
UC-3	Base (Long Term) Timetable Submission on Demand (TfNSW generated notifications)	TfNSW may trigger notifications to Operators if the base timetable is falling short of 90 days forecast timetable data. The Operator and is expected to respond by refreshing the base timetable.	-
UC-4	Short Term Timetable Variation	A short term change is made to the base timetable	-
UC-5	Day of Operation (Next Day) Timetable Submission	A change in timetable is made for the following day	-

6.2 UC-1 Base (Long Term) Timetable Establishment

6.2.1 Description

As part of on-boarding of any new Operator, TfNSW expects that the Operator will establish a base timetable.

This base timetable must be established once when a new Operator is on-boarded and must meet below criteria –

- Base timetable must contain atleast 90 days worth of forecast scheduled timetable data
- It must be sent no lesser than 3 weeks (21 days) in advance
- Applicable to all modes – LightRail/Tram, Metro, Buses, Trains etc.

6.2.2 Interaction Diagram

Below diagram explains the system/user interaction

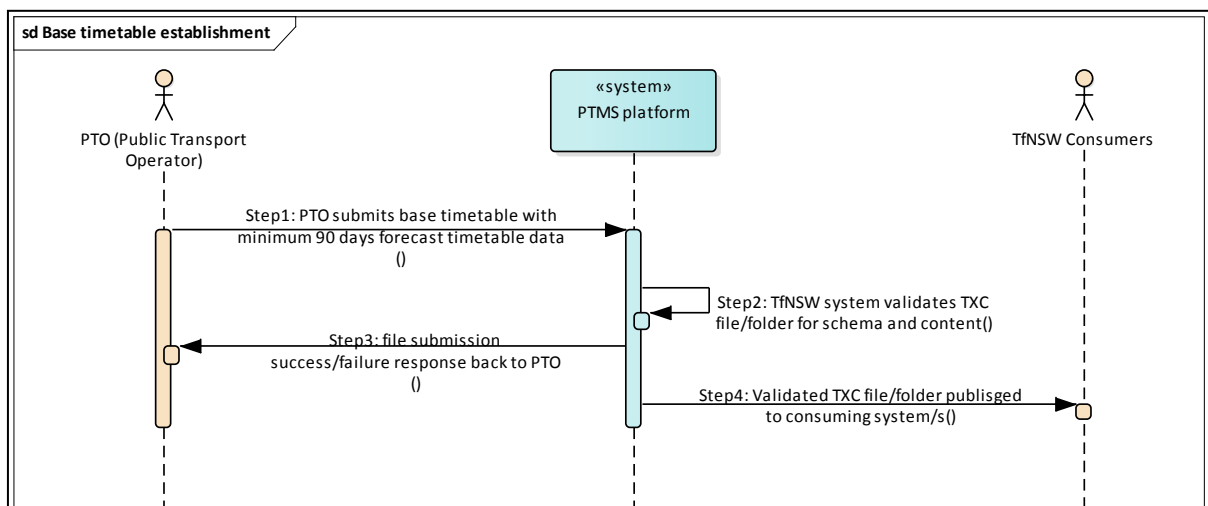


Figure 17 - Base Timetable Establishment Process

6.3 UC-2 Base (Long Term) Timetable Periodic Refresh

6.3.1 Description

At any given time, base timetable should have data with validity no less than 90 days. Hence, it is expected that the Operator will submit a long term timetable periodically.

In order to maintain base timetable forecast to rolling 90 days, the Operator should send a base timetable with a validity of 90 days every week at a specified day/time.

For example, the Operator sends a base timetable refresh on 13th Jan 2019, then the TXC should have a validity from 13th Jan 2019 to 13th April, 2019 as a minimum.

6.3.2 Interaction Diagram

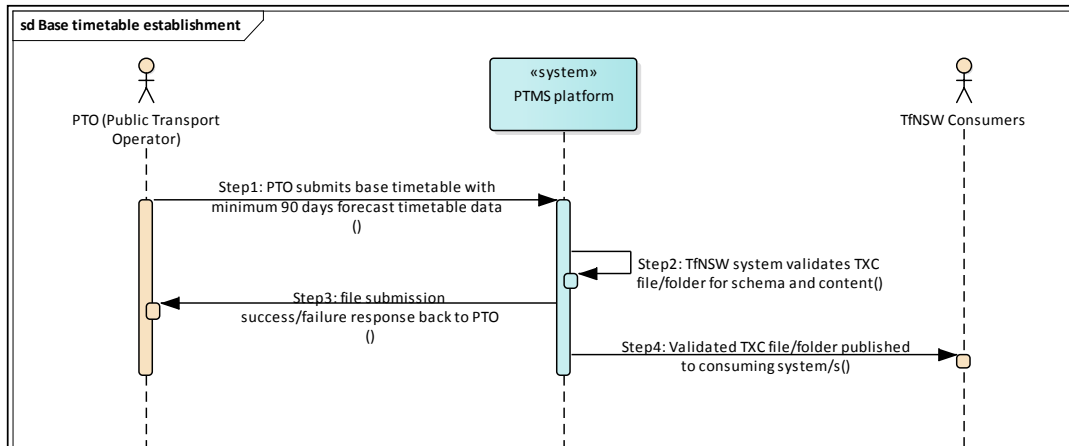


Figure 18 - Base Timetable Periodic Refresh Process

6.4 UC-3 Base (Long Term) Timetable Submission On Demand

6.4.1 Description

At any given time, an Operator’s base timetable should extend a minimum of 90 days into the future. If the base timetable present with TfNSW contains data less than 90 days forecast then TfNSW can generate notifications to the Operator for a refresh of timetable.

6.4.2 Interaction Diagram

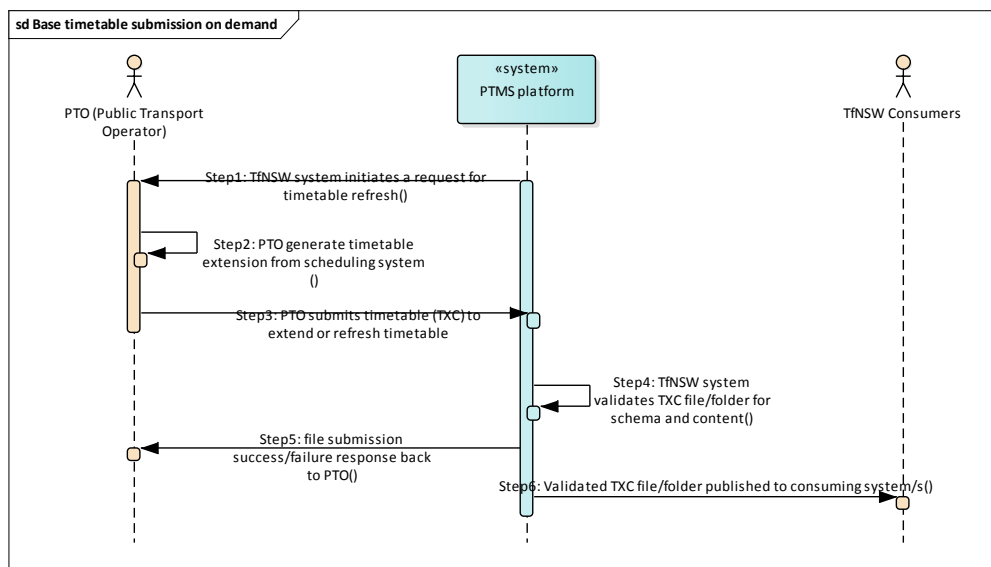


Figure 19 - Base Timetable Submission On Demand Process

6.5 UC-4 Short Term Timetable Variation

6.5.1 Description

Due to planned events, the base timetable needs refresh then in that case full TxC should be sent by Operator, reflecting short term changes

90 day base timetable has been established from 1-02-2019 to 1-05-2019.

This base timetable captures all the Journey Patterns and Vehicle Journeys for the duration.

For an planned events like Vivid, variations to the timetable can be already be captured in the base timetable by defining Vehicle Journey with "Days of Operation/Non-Operation"

However, in case of unforeseen or unplanned events (track works or strike), if a base timetable need changes for durations lesser than 90 days (let's say strike changes timetable for 2 weeks from 14-02-2019 to 28-02-) then such scenarios should be catered in TxC as well.

6.5.2 Interaction Diagram

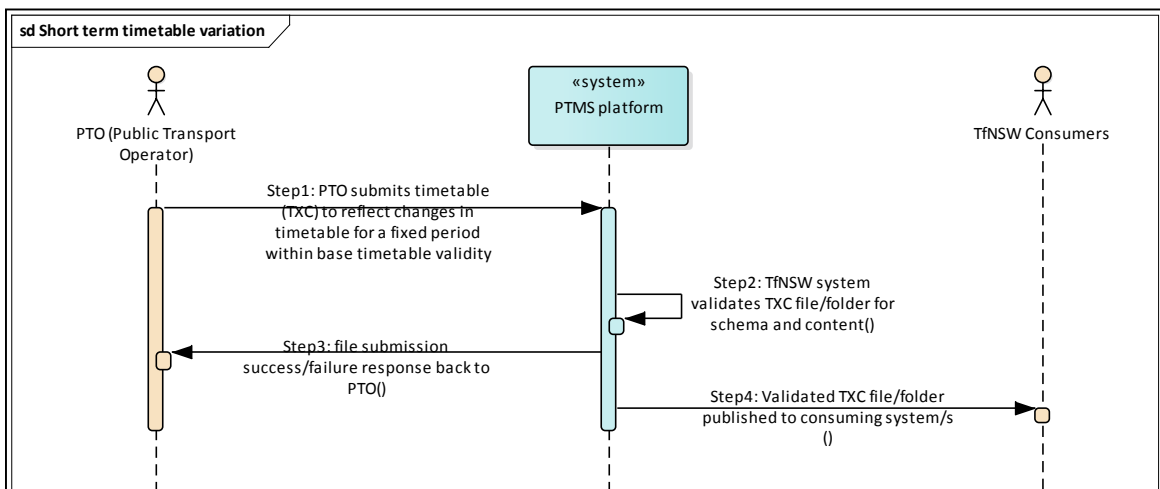


Figure 20 - Short Term Timetable Variation Process

6.6 UC-5 Day of Operation (Next Day) Timetable Submission

6.6.1 Description

In this scenario, a base timetable has been established and services are running as per the timetable. However, due to an unplanned incident trams cannot drop or pick-up passengers from some of the stops on a route. Hence, services will run on limited stops for a day (next day).

6.6.2 Interaction Diagram

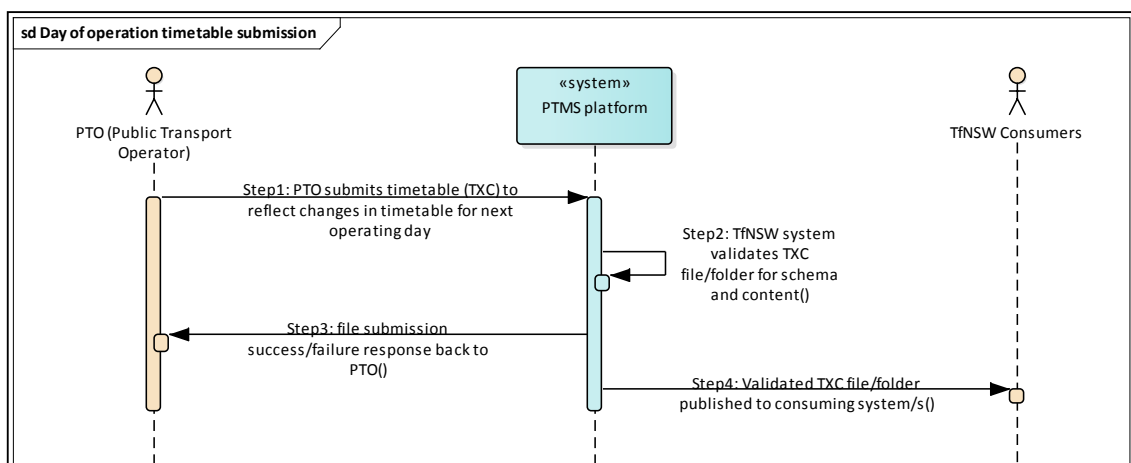


Figure 21 – Day of Operation Timetable Submission Process

Appendices

A. TransXChange vs NeTeX Comparison

In the longer term, TfNSW seeks to build atop TransXChange in order to broaden the range of information it can supply to customers, e.g. internal building routing, carpark details. The industry standard interface aligning to that use case is NeTeX. The diagram below seeks to show the delta between TransXChange and NeTeX.

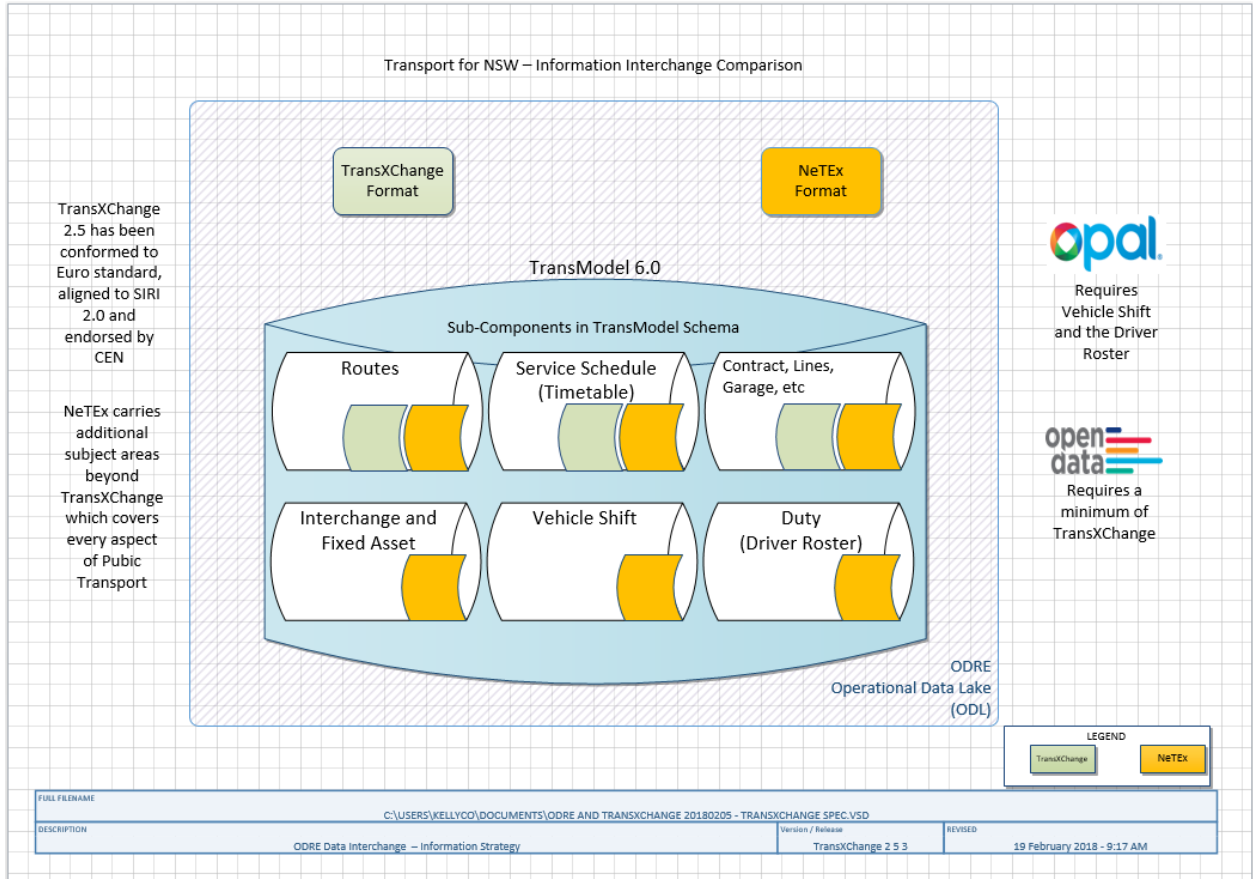


Figure 22- TransXChange vs NeTeX Coverage

B. TransXChange to GTFS Mapping

The ODRE PTMS platform at TfNSW has the ability to take a TransXChange document submitted by an Operator and transform the content so that it becomes available as a GTFS static timetable.

The diagram below illustrates how the data elements within a TransXChange document are mapped to the corresponding GTFS files.

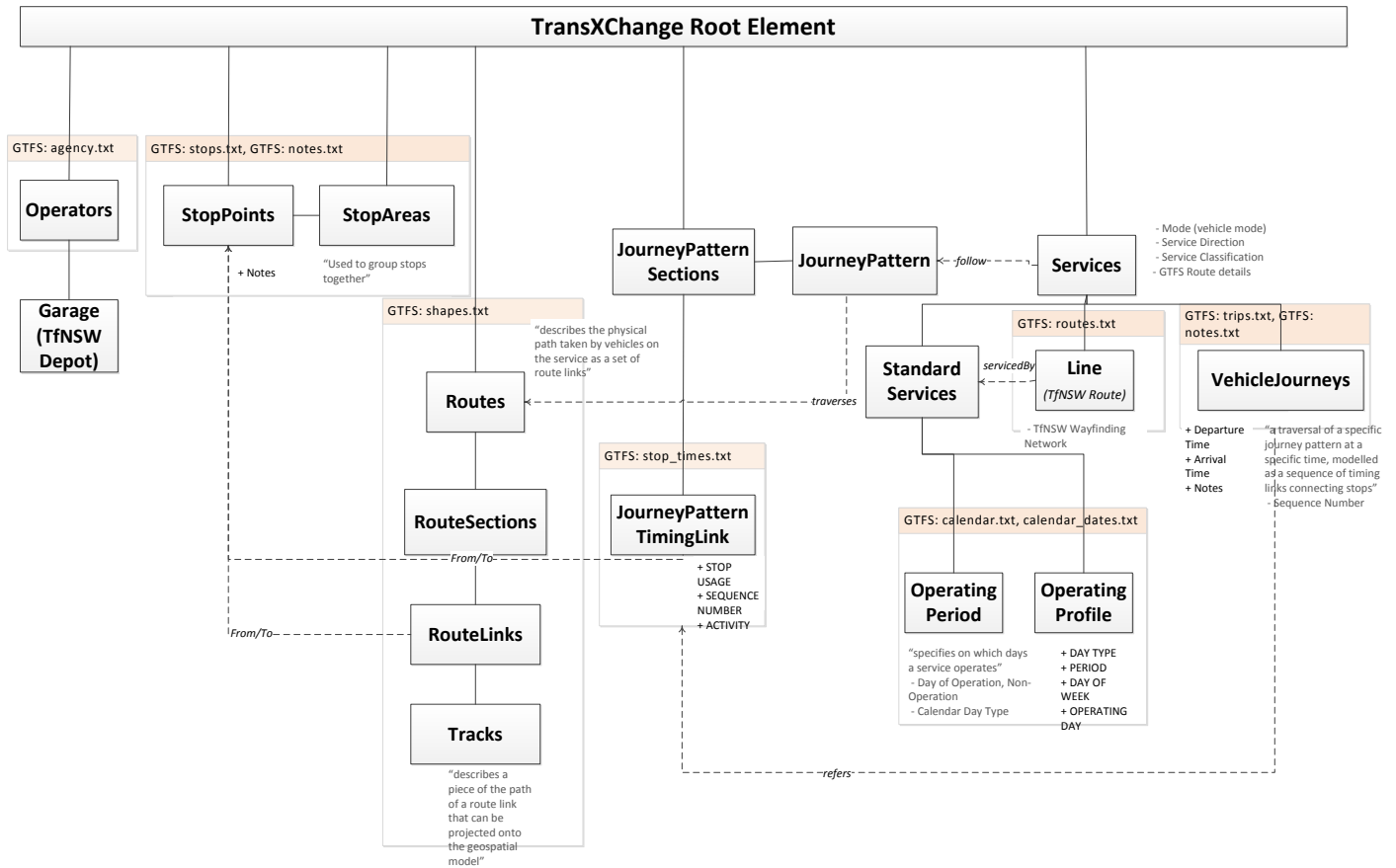


Figure 23 – Inter-Relationship Between TransXChange Elements and GTFS Static Files

End of Document