Department for Transport

TransXChange – An XML Standard for the Data
Exchange of Bus Schedules and Related
Information.

TransXChange Schema Guide

2.1 & 2.2a (v4.45)

Version History

Schema	Version	Date		Review
2.0a	0.1 Preliminary Consultation Draft	03 04 2004	NJSK	Review
2.0b	0.4 Consultation Draft	10 03 2004	RM /NJSK	Review
2.0c	0.9 Consultation Draft	11 05 2004	NJSK	Review
2.0c	0.10 Consultation Draft Corrections	12 05 2004	/NJSK	Review
2.0c	0.15 Corrections, added dead run, track & revised operation date sections.	14 05 2004	NJSK	Internal
2.0d	0.16 Corrections.	09 06 2004	TW	Internal
2.0d	0.19 Internal Draft. NaPTAN 2a & Publisher updates	23 06 2004	NJSK	Review
2.0e	0.20 Further NaPTAN 2b changes. Rework FlexibleService. Revise Frequent Service and Operational dates.	01 07 2004	NJSK	Internal
2.0e	0.23 Corrections. Registration change, Move Examples to web	16 07 2004	NJSK	Internal
2.0e	0.25 Clarifications & Corrections	15 08 2004	NJSK	Internal
2.0e	0.26 Minor formatting corrections	18 08 2004	NJSK	Review
2.0f	0.27 Add Public Use,	26 08 2004	NJSK	Review
2.0f	0.31 Corrections, renumber figures and tables, Add Booking Arrangements, Legislative references, Block, Refine integrity rules. Drop PPT	07 10 2004	NJSK	Internal
2.0g	0.32 Corrections. Revise Transmodel comparison, Refine integrity rules.	16 12 2004	NJSK	Review
2.0g	0.33 Corrections. From RS	23 01 2005	NJSK	Review
2.0g	0.34 Clarify MDV points	30 02 2005	NJSK	Review
2.0	0.35 Release 2.0 Clarify versioning points	10 03 2005	NJSK	Final
2.1	0.36 Release 2.1 Minor fixes and corrections	27 09 2005	NJSK	Issued
2.1	0.37 Minor fixes and corrections	06 01 2006	NJSK	Issued
2.1	0.38 Clarify use of duration	15 11 2006	NJSK	Review
2.1	0.39 Update with Publisher enhancements in route merge	16 03 2007	NJSK	Issued
2.1	0.40 Clarify route map, correct times, improve diagrams	14 07 2007	NJSK	Issued
2.2a	0.41 Clarify rounding ,	24 07 2007	NJSK	Review
2.2a	0.41 correct subsidy classification	24 09 2007	NJSK	Review
2.2a	0.42 correct clarify use of journey times classification	12 03 2008	NJSK	Issued
2.2a	0.43 clarify stop request	03 09 2008	NJSK	Issued
2.2a	0.44 Revise all diagrams	02 03 2009	NJSK	Issued
2.2a	0.45 Remove wrong reference to change classification	10 06 2009	NJSK	Issued
2.2a	0.46 Update validation table	10 09 2009		

Prepared By:

Kizoom Ltd
schemer@kizoom.com
109-123 Clifton Street London, EC2A 4LD

Tel: +44 (0)20 7566 1400
Fax: +44 (0)20 7566 0033
Email: nick_knowles z @rkizoom.com

Prepared For:

Department for Transport,
Great Minster House,
76 Marsham Street,
London,
SW1P 4DR

Department for Transport

CONTENTS
Section *Page*

VERSION HISTORY 2

CONTENTS 3

LIST OF FIGURES 9

LIST OF TABLES 12

1 INTRODUCTION 15
1.1 Antecedents 15
1.2 Document Structure 16
1.3 Intellectual Property Rights 17
1.3.1 TransXChange Schema 17
1.3.1.1 TransXChange Schedules 17
1.3.1.2 TransXChange Document Publisher 17
1.4 Versioning 18
1.5 Naming Conventions 18
1.6 Presentation Conventions Used in the Schema Guide 18
1.6.1 XML Elements in Text 18
1.6.1.1 UML Diagrams 18
1.6.1.2 XML Structure Diagrams 19
1.6.1.3 Element Structure – Sequence 19
1.6.1.4 Element Structure – Choice 19
1.6.1.5 Multiplicity and Optionality 19
1.7 Major Changes in Release 2.0 of TransXChange 20
1.8 Evolving TransXChange 21
1.9 Acknowledgments 21
1.10 Related Transport Information Standards 22
1.11 Legislation 22
1.12 Related Documents 23

2 OVERVIEW OF TRANSXCHANGE 24
2.1 The Purpose of TransXChange 24
2.2 TransXChange Elements 24
2.3 Document Validation 24
2.4 How is TransXChange Used? 26
2.4.1 Registration of a Route with VOSA 26
2.4.2 Update of a Registration with VOSA 26
2.4.3 General Purpose Exchange of Data 27
2.5 Differences between the Schemas 28

3 SHORT TOUR OF THE *TRANSXCHANGE* ESSENTIAL MODEL 29
3.1 Representing a Bus Service in *TransXChange* 29
3.2 The NaPTAN Stop Model 31
3.2.1 Resolving NaPTAN Stop References 34
3.2.2 Variable Stop Allocations 34
3.2.3 Stop Types 34
3.3 The Route and Service Supply Model 36
3.3.1 Model Layer Concerns 38
3.3.2 Summary of Route & Supply Model Elements 39

3.3.3 Projection between Levels of Discourse 39
3.3.4 The Use of Links in TransXChange 40
3.3.5 Structure Example of a Schedule with one Pattern and Two Journeys, 41
3.3.6 Structure Example of a Schedule with an Express Journey 42
3.3.7 An Instance Example 43
3.3.8 Plotting a route on a Map 43
3.4 Inheriting Timing Link Values 45
3.4.1 Inheritable attributes 46
3.4.2 Schedule and Journey Terms and Definitions 48
3.4.2.1 Time Related Terms 48
3.4.2.2 Routing Related Terms 48
3.4.3 Computation of Passing Times 50
3.4.3.1 Example of Inheritance of Passing Times 51
3.5 Rounding of Passing Times 53
3.6 Standard Service Overview 54
3.6.1 Standard Service properties 55
3.7 Flexibly Routed Services 57
3.8 Interchanges 60
3.8.1 Inheriting Interchange Values 61
3.8.2 Interchange Schematic 62
3.8.3 Interchange Instance Example 62
3.9 Fare Stages 65
3.10 Dead Runs 66
3.10.1 Use of Dead Runs for Short Working 67
3.11 Tracks 68
3.11.1 Track Model 70
3.12 The Registration Model 71
3.12.1 Populating a Registration 73
3.13 Operators 73
3.14 Further Modelling Topics 73
3.14.1 Direction: Handling Inbound and Outbound Schedules. 73
3.14.2 Modelling Complex Routes 76
3.14.2.1 Services with Topologically Complex Routes 76
3.14.2.2 Services with Complex Temporal Operational Patterns 78
3.14.3 Modelling Services Efficiently 79
3.14.3.1 Overall Reuse of Elements 80
3.14.3.2 Inefficiencies in TransXChange 80
3.14.3.3 Use of Sections 81
3.14.4 Presenting Schedules in Timetables 82
3.14.4.1 Using a Sequence Number 83
3.14.4.2 Example of a Timetable using StopSequence 84
3.14.5 Associating operational data with a timetable 85
3.15 Modelling Operational Days 87
3.15.1 Specifying When the Service Operates – Summary 87
3.15.2 Regular Operation – OperatingProfile 89
3.15.3 Exceptional Operation – OperatingProfile 89
3.15.4 Services that Run for Specific ServicedOrganisation Working Days91
3.15.5 OperatingProfile Elements 92
3.15.6 General Principles for Using Operational Days 94
3.15.7 Frequent Services 95
3.15.8 Frequency Based Services 95
3.15.8.1 Frequency Described by Interval 95
3.15.8.2 Departure Described by Minutes Past Hour 96
3.15.8.3 Frequency Described on Multiple Individual Journeys 96
3.15.8.4 Multi-journey to single group, Multiple frequencies 97
3.15.8.5 Text Descriptions for Frequency service 97
3.15.9 Service Operational Days 98
3.15.10 Structure Example of Schedule with Operational Day Exceptions 99

3.16 Summary of TransXChange Entities and Identifiers 100
3.16.1 Private codes 101
3.16.2 Referencing Elements 101
3.17 Data types 102

4 WORKED EXAMPLE OF A TRANSXCHANGE SCHEDULE 105

4.1 Worked Example: Bus Timetable 105
4.2 Worked Example: Service Components 105
4.3 Worked Example: Operator 105
4.4 Worked Example: Registration 106
4.5 Worked Example: StopPoints 106
4.6 Worked Example: Route and Tracks 106
4.7 Worked Example: JourneyPattern 108
4.8 Worked Example: Line 109
4.9 Worked Example: VehicleJourney 109
4.10 Worked Example: Operational Times 109

5 EXAMPLES 111

6 TRANSXCHANGE SCHEMA 113

6.1 TransXChange Schema Overview 113
6.2 TransXChange Root Element 113
6.2.1 TransXChange Element Attributes 113
6.2.2 TransXChange Child Elements 114
6.3 Topographical Elements – StopPoints and Zones 116
6.3.1 NptgLocalities Element 116
6.3.2 AnnotatedNptgLocalityRef Element 116
6.3.3 StopPoints Element 117
6.3.4 AnnotatedStopPointRef Element 117
6.3.5 StopPoint Element (Stop) 118
6.3.6 StopArea Element (StopGroup / StopCluster) 118
6.4 Network Topology Elements – Routes and Tracks 120
6.4.1 Route Element 120
6.4.2 RouteSection Element 120
6.4.3 RouteLink Element 121
6.4.4 Track Element 122
6.4.5 Track Subelements 122
6.4.5.1 Track / Mapping Element 122
6.4.5.2 Track / Instructions Element 122
6.4.5.3 Track / Instructions / Feature Element 123
6.5 Registration Elements: Operator, Registration, ShortNoticeRegistration125
6.5.1 Operators Element 125
6.5.2 Operator Element 125
6.5.3 LicensedOperator Element 126
6.5.4 Operator & LicensedOperator: Subelements 127
6.5.4.1 OperatorContactGroup 127
6.5.4.2 Operator / Garages Element 128
6.5.5 Registration Element 128
6.5.6 RegistrationSubmissionGroup 129
6.5.7 RegistrationInfoGroup 130
6.5.8 Registration Subelements 131
6.5.8.1 Registration / VosaRegistrationNumber Element 131
6.5.8.2 Registration / SubmissionAuthor Element 132
6.5.8.3 Registration / TrafficArea Element 132
6.5.8.4 Registration / CirculatedAuthorities Element 133
6.5.8.5 Registration / SubsidyDetails Element 137

6.5.8.6 Registration / ContractedService Element 137
6.5.8.7 Registration / SupportingDocument Element 137
6.5.9 ShortNoticeRegistration Element 138
6.5.10 ShortNoticeRegistration / ChangeImpactGroup 138
6.5.11 ShortNoticeRegistration / ChangeJustificationGroup 138
6.5.12 ShortNoticeRegistration Subelements 139
6.5.12.1 ShortNoticeRegistration / Public Availability Element 139
6.5.12.2 ShortNoticeRegistration / ChangeImpact Element 140
6.5.12.3 ShortNoticeRegistration / ChangeToConnectAlteredService Element 140
6.5.12.4 ShortNoticeRegistration / ReplaceDiscontinuedService Element140
6.5.12.5 ShortNoticeRegistration / LocalHolidayChange Element 141
6.5.12.6 ShortNoticeRegistration / SpecialOccasion Element 141
6.5.12.7 ShortNoticeRegistration / RegulationOrderCompliance Element141
6.5.12.8 ShortNoticeRegistration / ChangeRequestedByExternalAuthority Element 142
6.5.12.9 ShortNoticeRegistration / ExceptionalRequirement Element 142
6.6 Service Description Elements 143
6.6.1 Services Element 143
6.6.2 Service Element 143
6.6.3 Service / ServiceInfoGroup 144
6.6.4 Service / ServiceDescriptionGroup 145
6.6.5 Service / ServiceComponentGroup 146
6.6.6 Service / Subelements 147
6.6.6.1 Service / Line Element 147
6.6.6.2 Service / OperatingPeriod Element 147
6.6.6.3 Service / ServiceClassification Element 147
6.6.6.4 Service / AssociatedOperators Element 148
6.6.6.5 Service / StopRequirements Element 149
6.6.6.6 Service / ServiceAvailability Element 149
6.6.6.7 Service / ToBeMarketedWith Element 149
6.7 StandardService, JourneyPattern, VehicleJourney 151
6.7.1 StandardService Element 151
6.7.2 JourneyPatterns 152
6.7.3 JourneyPattern Element 152
6.7.3.1 JourneyPattern / CommonJourneyGroup 153
6.7.3.2 JourneyPattern / JourneyPatternGroup 154
6.7.4 JourneyPattern Subelements 155
6.7.4.1 CommonJourneyGroup JourneyPattern / Operational Element 155
6.7.4.2 CommonJourneyGroup JourneyPattern / Operational / TicketMachine Element 155
6.7.4.3 CommonJourneyGroup JourneyPattern / Block Element 156
6.7.4.4 CommonJourneyGroup / VehicleType Element 156
6.7.4.5 CommonJourneyGroup / LayoverPoint Element 156
6.7.5 JourneyPatternSection Element 157
6.7.6 JourneyPatternTimingLink Element 157
6.7.6.1 JourneyPatternTimingLink / CommonTimingLinkGroup 158
6.7.6.2 JourneyPatternTimingLink / JourneyPatternTimingLinkGroup 158
6.7.7 JourneyPatternStopUsageStructure 159
6.7.7.1 JourneyPatternStopUsage / JourneyStopUsageGroup 160
6.7.7.2 JourneyPatternStopUsage / JourneyPatternStopUsageGroup 161
6.7.7.3 VariableStopAllocations Element 162
6.7.8 JourneyPatternInterchange Element 163
6.7.8.1 JourneyPatternInterchange / CommonInterchangeGroup 163
6.7.8.2 JourneyPatternInterchange / InterchangeInfoGroup 164
6.7.8.3 JourneyPatternInterchange / JourneyPatternInterchangeGroup 165
6.7.9 VehicleJourney Element 166
6.7.9.1 VehicleJourney / VehicleJourneyGroup 166
6.7.9.2 VehicleJourney / StandardVehicleJourneyGroup 167

6.7.10 Common VehicleJourney Subelements 168
6.7.10.1 VehicleJourney / DeadRun Element 168
6.7.10.2 VehicleJourney / PositioningLink Element 168
6.7.10.3 VehicleJourney / PositioningLink / PositioningStopUsageStructure 169
6.7.10.4 VehicleJourney / Frequency Element 169
6.7.11 VehicleJourneyTimingLink Element 170
6.7.11.1 VehicleJourneyTimingLink / VehicleJourneyTimingLinkGroup 170
6.7.12 VehicleJourneyTimingLink / VehicleJourneyStopUsage Element 171
6.7.13 VehicleJourneyTimingLink / VehicleJourneyInterchange Element 171
6.7.13.1 VehicleJourneyTimingLink / VehicleJourneyInterchangeGroup 172
6.8 FlexibleService, FlexibleJourneyPattern, FlexibleVehicleJourney 173
6.8.1 FlexibleService Element 173
6.8.1.1 FlexibleJourneyPattern Element 173
6.8.1.2 FlexibleJourneyPattern / FlexibleJourneyPatternGroup 173
6.8.2 FlexibleService Subelements 174
6.8.2.1 FlexibleService / StopUsage Element 174
6.8.2.2 FlexibleService / FlexibleStopUsage Element 174
6.8.2.3 FlexibleVehicleJourneyGroup / BookingArrangements Element 175
6.8.3 FlexibleVehicleJourney Element 175
6.8.3.1 FlexibleVehicleJourneyGroup / FlexibleServiceTimes Element 176
6.9 Operational Days & Times 177
6.9.1 OperatingProfile Element 177
6.9.1.1 Normal OperatingProfileGroup 177
6.9.1.2 Special OperatingProfileGroup 177
6.9.2 OperatingProfile Subelements 178
6.9.2.1 OperatingProfile / RegularDayType Element 178
6.9.2.2 OperatingProfile / RegularDayType / DaysOfWeek Element 178
6.9.2.3 OperatingProfile / PeriodicDayType / WeekOfMonth Element 179
6.9.2.4 SpecialDaysOperation Element: DaysOfOperation, DaysOfNonOperation 179
6.9.2.5 DateRange 180
6.9.2.6 OperatingProfile / BankHolidayOperation 180
6.9.2.7 OperatingProfile / BankHoliday Elements 181
6.9.3 ServicedOrganisation Element 183
6.9.4 ServicedOrganisation Subelements 183
6.9.4.1 ServicedOrganisation / DatePattern Element 183
6.10 Miscellaneous Elements 184
6.10.1 SupportingDocument Element 184

7 COMMON SCHEMA ELEMENTS 185

7.1 LocationStructure 185
7.2 Duration Simple Type 186
7.3 TelephoneContactStructure Element 186
7.4 PostalAddressStructure Element 186
7.5 Note Element 186

8 ELECTRONIC BUS SERVICE REGISTRATION PROCESS 188

8.1 Step 1: Preparation 188
8.2 Step 2: Encoding 188
8.3 Step 3: Transmission 188
8.4 Step 4: Validation 188
8.5 Step 5: TAN Review 189
8.6 Step 6: Acceptance and Distribution 189

9 THE TRANSXCHANGE PUBLISHER 190

9.1 Required Environment 191

9.2 Installation Process 191
9.3 Run Time Options 191
9.4 Generalised list of Publisher parameters 191
9.5 Publishing Actions 192

10 NAMING & CODING CONVENTIONS 194

10.1 Naming of Elements 194
10.1.1 Use of Camel Case 194
10.1.2 Use of Standard Name Suffixes 194
10.1.3 Meaningful Names 194
10.1.4 Semantically Significant Order 195
10.1.5 Standardised Terminology 195
10.2 Typing of Elements 195
10.3 Element Constraints 195
10.4 Use of Attributes 196
10.5 Implementation of Model Relationships 196

11 NATIONAL LANGUAGE SUPPORT 197

11.1 Text Content Types 197
11.1.1 Use of Fixed Text 197
11.1.2 Use of Free Text 197
11.1.3 External Data 198
11.2 Publishing or Exchanging Documents 198

12 VERSIONING 199

12.1 Version Numbering Convention 199
12.2 Resource Versions 199
12.2.1 Schema URI Version 199
12.2.2 Namespace URI Version 199
12.2.3 Package Versions 199
12.3 Packages 200
12.4 Version Identifiers & Change Tracking 202
12.4.1 Schema Version Identifier 202
12.4.2 Indicating Versions on Data 202
12.4.3 Data Element Version 202
12.4.4 Change Trackable Entities 203
12.5 Names of TransXChange Files 203

13 TRANSMODEL & TRANSXCHANGE COMPARISON 205

13.1 Transmodel Principles 205
13.2 Transmodel Terminology 206
13.3 Divergences from Transmodel 207
13.3.1 TransXChange Representation of Journey Patterns 207
13.3.2 Abbreviated Journey Patterns 207
13.3.3 Groups of Links 208

14 INTEGRITY RULES 209

14.1 Syntactic Integrity Rules 209
14.2 Semantic Integrity Rules 210
14.3 Ordered Relationships 214
14.4 Precedence Rules for Combining General Date Elements 214

15 APPENDIX A – REFERENCES TO OTHER STANDARDS 217

15.1 Transport Domain 217

15.1.1 NaPTAN & NPTG 217
15.1.2 JourneyWeb 217
15.1.3 Transmodel CEN TC 278 217
15.2 Software & General 217
15.2.1 XML Schema 217
15.2.2 ISO Time Formats 217
15.2.3 WGS 1984 Location Referencing 218
15.2.4 ISO 639-1 Names of Languages 218
15.2.5 Rfc 1766 Tags for the Identification of Languages 218
15.2.6 GovTalk XML Coding Standards 218
15.2.7 UML Unified Modelling Language 218

16 APPENDIX B - NEW FUNCTIONS IN TRANSXCHANGE 2.0 & 2.1 _219

16.1 Changes in 2.1 220

17 APPENDIX C – COMPARISON OF TERMINOLOGY TRANSXCHANGE 2.0 220

List of Figures

Figure 1-1 – XML Spy Diagram: Sequence 19
Figure 1-2 – XML Spy Diagram: Choice 19
Figure 1-3 – XML Spy Diagram: Multiplicity........ 20
Figure 2-1 – Overview of TransXChange Use 26
Figure 2-2 – Common Set of Types in TransXChange Schemas........ 28
Figure 3-1 – UML Overview of TransXChange Model for a StandardService 30
Figure 3-2 – UML Diagram of Elaboration of TransXChange model........ 31
Figure 3-3 – UML Diagram of Summary of Stop Model 32
Figure 3-4 – UML Diagram of NaPTAN Stop elements........ 33
Figure 3-5 – UML Diagram of Stop Classification Model 35
Figure 3-6 – UML Diagram of Route, JourneyPattern and VehicleJourney Models 37
Figure 3-7 – Service Model Layer Concerns........ 38
Figure 3-8 – Correspondence between Links at Different Levels........ 39
Figure 3-9 – Simple Route Map........ 41
Figure 3-10 – UML Instance Diagram of Example of Link Model 44
Figure 3-11 UML Diagram of Service Pattern elements........ 46
Figure 3-12 – UML Diagram of VehicleJourney & JourneyPattern Inheritable Properties ... 47
Figure 3-13 – Computation of Passing Times........ 51
Figure 3-14 – UML Diagram of Standard Service 55
Figure 3-15 – UML Diagram of Standard Service Details 56
Figure 3-16 – Flexible Network........ 57
Figure 3-17 – UML Diagram for Flexibly Routed Service........ 59
Figure 3-18 – UML Diagram of Interchanges........ 61
Figure 3-19 – Interchange Links........ 62
Figure 3-20 – UML Instance Diagram of Example Interchange 64
Figure 3-21 – Fare Stages & Links........ 65
Figure 3-22 – UML Diagram of Dead Run Model........ 66
Figure 3-23 – UML Diagram of Track Model........ 69
Figure 3-24 – UML Diagram of Basic Registration Model 71
Figure 3-25 – UML Diagram of TransXChange Registration........ 72
Figure 3-26 – UML Diagram of TransXChange Operator Model........ 73
Figure 3-27 – Journey Directions........ 75
Figure 3-28 – Topology: Circular Route........ 77
Figure 3-29 – Topology: Lollipop Route........ 77

Figure 3-30 – Topology: Cloverleaf Route 77
Figure 3-31 – Reuse of Elements 80
Figure 3-32 – Example of Sections 81
Figure 3-33 – Example: Use of Stop Sequencing 84
Figure 3-34 – UML Diagram of Operational data elements 86
Figure 3-35 – UML Diagram Overview of Operational Times 88
Figure 3-36 – UML Diagram of Normal Operation Profile 89
Figure 3-37 – UML Diagram of Special Operation Profile 90
Figure 3-38 – UML Diagram of Serviced Organisation Days 91
Figure 3-39 – UML Diagram of Operational Time Elements 93
Figure 3-40 UML Diagram of XML base Data types 102
Figure 3-41 – UML Diagram of Additional base types use dby NaPTAN 102
Figure 3-42 – UML Diagram of NaPTAN Location Types 102
Figure 3-43 – UML Diagram of NPTG base types 103
Figure 3-44 – UML Diagram of NaPTAn base types 103
Figure 3-45 – UML Diagram of TransXChange simple identifier types 104
Figure 3-46 – UML Diagram of TransXChange other base types 104
Figure 4-1 – Worked Example: Map of the Route 107
Figure 4-2 – Worked Example: Journey Pattern 108
Figure 6-1 – Top Level Elements of TransXChange 115
Figure 6-2 – NptgLocalities Element 116
Figure 6-3 – AnnotatedNptgLocalityRef Element 117
Figure 6-4 – StopPoints Element 117
Figure 6-5 – Annotated StopPointRef Element 118
Figure 6-6 – Route Element 120
Figure 6-7 – RouteSection Element 120
Figure 6-8 – RouteLink Element 121
Figure 6-9 – Track Element 122
Figure 6-10 – Mapping Element 122
Figure 6-11 – Instructions Element 123
Figure 6-12 – Operators Element 125
Figure 6-13 – Operator Element 126
Figure 6-14 – LicensedOperator Element 127
Figure 6-15 – Operator / OperatorContactGroup 128
Figure 6-16 – Operator / Garages / Garage Element 128
Figure 6-17 – Registration Element 129
Figure 6-18 – RegistrationSubmissionGroup 130
Figure 6-19 – RegistrationInfoGroup 131
Figure 6-20 – Registration / VosaRegistrationNumber Element 132
Figure 6-21 – Registration / SubmissionAuthor Element 132
Figure 6-22 – Registration / TrafficArea Element 133
Figure 6-23 – Registration / CirculatedAuthorities Element 136
Figure 6-24 – Registration / SubsidyDetails Element 137
Figure 6-25 – Registration / ContractedService Element 137
Figure 6-26 – Registration / SupportingDocument Element 137
Figure 6-27 – ShortNoticeRegistration Element 138
Figure 6-28 – ShortNoticeRegistration / ChangeImpactGroup 138
Figure 6-29 – ShortNoticeRegistration / ChangeJustificationGroup 139
Figure 6-30 – ShortNoticeRegistration / PublicAvailability Element 140
Figure 6-31 – ShortNoticeRegistration / ChangeImpact Element 140
Figure 6-32 – ShortNoticeRegistration / ChangeToConnectAlteredService Element 140
Figure 6-33 – ShortNoticeRegistration / ReplaceDiscontinuedService Element 141
Figure 6-34 – ShortNoticeRegistration / LocalHolidayChange Element 141

Figure 6-35 – ShortNoticeRegistration / SpecialOccasion Element 141
Figure 6-36 – ShortNoticeRegistration / RegulationOrderCompliance Element 142
Figure 6-37 – ShortNoticeRegistration / ChangeRequestedByExternalAuthority Element 142
Figure 6-38 – ShortNoticeRegistration / ExceptionalRequirement Element 142
Figure 6-39 – Service Element 144
Figure 6-40 – Service / ServiceInfoGroup.. 145
Figure 6-41 – Service / ServiceDescriptionGroup.. 146
Figure 6-42 – Service / ServiceComponentGroup 146
Figure 6-43 – Service / Line Element 147
Figure 6-44 – Service / OperatingPeriod Element 147
Figure 6-45 – Service / ServiceClassification Element... 148
Figure 6-46 – Service / AssociatedOperators Element 149
Figure 6-47 – Service / StopRequirements Element 149
Figure 6-48 – Service / ServiceAvailability Element... 149
Figure 6-49 – Service / ToBeMarketedWith Element 150
Figure 6-50 – StandardService Element... 151
Figure 6-51 – JourneyPattern Element... 153
Figure 6-52 – JourneyPattern / CommonJourneyGroup 154
Figure 6-53 – JourneyPattern / JourneyPatternGroup 155
Figure 6-54 – JourneyPattern / Operational Element... 155
Figure 6-55 – JourneyPattern / TicketMachine Element 156
Figure 6-56 – JourneyPattern / Block Element 156
Figure 6-57 – JourneyPattern / VehicleType Element.. 156
Figure 6-58 – JourneyPattern / LayoverPoint Element 157
Figure 6-59 – JourneyPatternSection Element 157
Figure 6-60 – JourneyPatternTimingLink Element... 157
Figure 6-61 – JourneyPatternTimingLink / CommonTimingLinkGroup............................. 158
Figure 6-62 – JourneyPatternTimingLink / JourneyPatternTimingLinkGroup 159
Figure 6-63 – JourneyPattern / JourneyPatternStopUsageStructure 160
Figure 6-64 – JourneyPattern / JourneyStopUsageGroup 161
Figure 6-65 – JourneyPattern / JourneyPatternStopUsageGroup.................................... 162
Figure 6-66 – JourneyPattern / VariableStopAllocation Element...................................... 163
Figure 6-67 – JourneyPatternInterchange Element 163
Figure 6-68 – CommonInterchangeGroup 164
Figure 6-69 – JourneyPatternInterchange / InterchangeInfoGroup 165
Figure 6-70 – JourneyPatternInterchange / JourneyPatternInterchangeGroup 165
Figure 6-71 – VehicleJourney Element... 166
Figure 6-72 – VehicleJourney / VehicleJourneyGroup... 167
Figure 6-73 – VehicleJourney / StandardVehicleJourneyGroup....................................... 167
Figure 6-74 – VehicleJourney / DeadRun Element.. 168
Figure 6-75 – DeadRun / PositioningLink Element 168
Figure 6-76 – DeadRun / PositioningLinkUsageStructure.. 169
Figure 6-77 – VehicleJourney / Frequency Element 170
Figure 6-78 – VehicleJourneyTimingLink Element... 170
Figure 6-79 – VehicleJourneyTimingLinkGroup... 171
Figure 6-80 – VehicleJourneyStopUsage Element 171
Figure 6-81 – VehicleJourneyInterchange Element 172
Figure 6-82 – VehicleJourneyInterchangeGroup 172
Figure 6-83 – FlexibleService Element... 173
Figure 6-84 – FlexibleJourneyPattern Element.. 173
Figure 6-85 – FlexibleJourneyPattern Element.. 174
Figure 6-86 – FlexibleServicePointsStructure Element.. 174
Figure 6-87 – FlexibleService / FlexibleStopUsage Element 175

Figure 6-88 – FlexibleVehicleJourney / BookingArrangements Element 175
Figure 6-89 – FlexibleVehicleJourney 176
Figure 6-90 – FlexibleVehicleJourney / FlexibleServiceTimes Element 176
Figure 6-91 – OperatingProfile Element 178
Figure 6-92 – OperatingProfile / RegularDayType Element 178
Figure 6-93 – OperatingProfile / DaysOfWeek Element 179
Figure 6-94 – OperatingProfile / WeekOfMonth Element 179
Figure 6-95 – OperatingProfile / SpecialDaysOfOperation Element 180
Figure 6-96 – DateRange Element 180
Figure 6-97 – OperatingProfile / BankHolidayOperation Element 180
Figure 6-98 – OperatingProfile / Bank Holidays Element 182
Figure 6-99 – ServicedOrganisation Element 183
Figure 6-100 – ServicedOrganisation / Date Pattern 184
Figure 6-101 – SupportingDocument Element 184
Figure 7-1 – LocationStructure 185
Figure 7-2 – TelephoneContactStructure 186
Figure 7-3 – PostalAddressStructure Element 186
Figure 7-4 – Note Element 187
Figure 9-1 – Publisher 190
Figure 12-1 – TransXChange Packages 200
Figure 12-2 – UML Diagram of Versioning Attributes 203

List of Tables

Table 1-1 – Forms for Registering Bus Services in England and Scotland 23
Table 2-1 – Differences between Schemas 28
Table 3-1 – Resolving Stop References 34
Table 3-2 – Correspondence between Links and Nodes 39
Table 3-3 – Structure Example of a Schedule 41
Table 3-4 – Structure Example of Schedule: Shared Journey Pattern 42
Table 3-5 – Structure Example of Schedule: Express VehicleJourney 42
Table 3-6 – Journey Properties and Defaults 45
Table 3-7 – Example of Computation of Inherited Passing Times 52
Table 3-8 – Example of Rounding of Passing Times 53
Table 3-9 – Interchange Properties and Defaults 62
Table 3-10 – Example Track Instructions 70
Table 3-11 – Example: Eye Timetable with Explicit Stop Sequencing 85
Table 3-12 – Example: Eye Timetable with Implicit Stop Sequencing 85
Table 3-13 – Precedence of Entity Levels 94
Table 3-14 – Precedence of Normal Operation Day Types 94
Table 3-15 Frequency Service Timetable: Representation 95
Table 3-16 – Example Frequent Service Timetable: Minutes 96
Table 3-17 – Example Frequent Service Timetable: Interval 96
Table 3-18 – Multi-journey Representation of Frequency Based journeys 97
Table 3-19 – Merged presentation of separate Frequency journeys with identical frequencies 97
Table 3-20 – Multi-journey Representation of Two Frequencies 97
Table 3-21 – Merged presentation of separate Journeys with different frequencies 97
Table 3-22 – Frequency service Text Descriptions 98
Table 3-23 – Main Entities of the TransXChange Model 101
Table 3-24 – References to Entities in the TransXChange Model 101
Table 4-1 – Worked Example: Bus Timetable 105
Table 4-2 – Worked Example: StopPoint Instances 106
Table 4-3 – Worked Example: RouteLink Instances 107

Table 4-4 – Worked Example: Timing Links for Journey Pattern 109
Table 4-5 – Worked Example: Timing Links for VehicleJourney 1A 109
Table 5-1 – TransXChange Examples 112
Table 6-1 – Allowed Values for Link / Direction 121
Table 6-2 – Allowed Values for FeatureType 123
Table 6-3 – Allowed Values for RelativeBearing 124
Table 6-4 – Allowed Values for LicenceClassification 125
Table 6-5 – Allowed Values for Registration / ApplicationClassification 129
Table 6-6 – Allowed Values for TanCode 131
Table 6-7 – Allowed Values for TrafficArea / Names 133
Table 6-8 – Allowed Values for CirculatedAuthority Names 136
Table 6-9 – Allowed Values for SubsidyType 137
Table 6-10 – Allowed Values for Service / Mode 145
Table 6-11 – Allowed Values for Service / Direction 146
Table 6-12 – Allowed ServiceClassification Combinations 148
Table 6-13 – Allowed Values for JourneyPattern / Direction 153
Table 6-14 – Allowed Values for TimeDemand 154
Table 6-15 – Allowed Values for VehicleJourney / Direction 158
Table 6-16 – Allowed Values for Activity 160
Table 6-17 – Allowed Values for TimingStatus 161
Table 6-18 – Allowed Values for TransferMode 164
Table 6-19 – Allowed Values for InterchangeActivity 165
Table 6-20 – AllBankHolidays by Country 181
Table 10-1 – TransXChange Attributes 196
Table 11-1 – Elements That May Contain Natural Language Text 198
Table 12-1 – TransXChange 2.0 Module Names 201
Table 12-2 – TransXChange Document Version Attributes 202
Table 12-3 – Entity Change Tracking Attributes 202
Table 12-4 – TransXChange Tracked Data Elements 203
Table 13-1 – Comparison of Key Transmodel Terms 206
Table 14-1 – Syntactic Integrity Rules 210
Table 14-2 – Severity Codes for Semantic Integrity Rules 210
Table 14-3 – Intrinsic & Extrinsic Semantic Integrity Rules 213
Table 14-4 – Ordered Relationships 214
Table 14-5 – Date Elements in Order of Precedence 216
Table 16-1 – Main Changes in TransXChange 2.0 from TransXChange 1.2 219
Table 17-1 – Terminology Cross-Reference 220

1 INTRODUCTION

TransXChange is a UK national data standard for the exchange of bus route and timetable information. The standard is sponsored by the UK Department for Transport and is mandated by the Vehicle Operating Services Agency (VOSA) for the electronic registration of UK bus services with Traffic Area Offices (TAO) and Local Authorities.

TransXChange allows the exchange of route and timetable information between, amongst others:

- Bus Service Operators
- Traffic Area Offices
- Local Authorities
- Passenger Transport Executives
- Traveline – the National Passenger Transport Information System
- Suppliers of AVL (Automatic Vehicle Location) and delivery systems

TransXChange comprises a W3C XML schema with related documentation and other tools.

This *Schema Guide* is intended to provide a technical overview and reference manual to *TransXChange* for system developers, data providers and other users of *TransXChange*.

The Guide is accompanied by a set of worked examples, available at the www.transxchange.org.uk web site. These provide explanations, diagrams and XML for using every feature of *TransXChange.* A summary table of the examples is given in Section 5.

Note that detailed documentation of individual schema elements is provided as annotations within the schema itself. Software Tools such as XML SPY can be used to explore the structure and details of the schema.

1.1 Antecedents

Version 1.0 of *TransXChange* was originally developed by Cap Gemini for the Traffic Area Network (TAN) under contract to the UK Department for Transport. The *TransXChange* model for public transport schedules was based on *Transmodel*, the European standard reference Data Model for Public Transport. *Transmodel* is intended:

- To promote a common integrated approach in the design of public transport information systems.
- To provide an open architecture for such systems.
- To provide a general model that can easily be adapted to create specific implementations.
- To support the reliable exchange of information between different software products.

An early version of *Transmodel* provided a starting point for the *TransXChange* Logical Reference Model that underpins the *TransXChange* XML schema. As a comprehensive, supplier-neutral, general purpose information model for transport information, *Transmodel* provides a valuable overall context of concepts and terminology extending over most aspects of public transport information (see Section 13). However, it should be noted that *Transmodel* is an abstract model, and it covers a wider scope of function than that required for *TransXChange*. Furthermore, *Transmodel* was expressed primarily in terms of an Entity-Relationship model, without the benefits of the encapsulation and richer constraints available in an Object-based language such as XML. A concrete XML implementation such as *TransXChange* must make a specific interpretation of the subset of *Transmodel* that is salient for its objectives, and must use the data types and other capabilities of its technology. The main divergences from *Transmodel* terminology are listed in section 13.2.

Subsequent updates, also managed by Cap Gemini, developed revised releases 1.1, 1.2, & 1.2.1

TransXChange version 2.0, is a major revision of the standard, managed by Carl Bro and Kizoom, which includes harmonisation with government standards for XML schemas, and addresses a number of issues exposed through early-adopters' experience of the initial earlier versions.

2.1 is a very minor update to 2.0 to harmonise with other changes to NaPTAN. All documents should be fully compatible with 2.1 tools for import.

Versions of the TransXChange Publisher, a tool used to produce human readable timetables from TransXChange documents was provided with release 2.0 and 2.1. A new enhanced version of the publisher was produced in 2007 including a desktop interface. This includes support for a preliminary draft 2.2a version of the 2.2 schema.

1.2 Document Structure

The *TransXChange Concept Guide* is organised as follows:

Part I – Introduction & Overview.
The chapters in Part I are intended to give a summary of the basic concepts and purpose of *TransXChange*:

- Information about the *TransXChange Concept Guide*.
- The Purpose of *TransXChange.*
- *TransXChange* Basic Concepts.
- *TransXChange* Logical Model.

Part II – Worked Examples.
Part II provides an example of the components of a *TransXChange* document.

- Simple Worked Example.
- It also provides an index to the systematic set of examples demonstrating the use of all *TransXChange* features that may be found at the web site.

Part III – Schema Structure.
The chapters in Part III provide a detailed account of the *TransXChange Schema* elements:

- Topographical Elements: Stops & Localities.
- Network Topographical Elements: Routes & Tracks.
- Service Description Elements.
- Operational Date & Time Elements.

Part IV – Technical Reference.
The chapters in Part IV provide technical details on various aspects of *TransXChange* documents and technology:

- Technical Annexes.
    - Registration Process

  - *TransXChange Publisher.*
  - Naming and Coding Conventions.
  - *Transmodel* comparison.
  - Versioning.
  - Integrity Rules.
- Reference Appendixes.

1.3 Intellectual Property Rights

1.3.1 TransXChange Schema

TransXChange is Crown Copyright, managed by the UK Department for Transport. The schema may be used without charge.

The *TransXChange* Schema may reference other Schemas that are also Crown Copyright, or that are owned by Associate Members of the UK Government GovTalk initiative.

Anyone who wishes to reproduce the Schema in any format must acknowledge the source and state that the Schema are the copyright of the named Associate Member or Crown Copyright, as appropriate. The permission to reproduce does not extend to any Schema or parts of Schema which are specifically identified as being the copyright of anyone who is not a Member or Associate Member. Permission to reproduce these Schema or parts of these Schemas must be obtained from the identified copyright holders.

TransXChange is based on open source software standards, notably XML.

The designated owner of the *TransXChange* schema for GovTalk is:

TransXChange, Transport Direct Project
Department for Transport,
Great Minster House,
76 Marsham Street,
London
SW1P 4DR

1.3.1.1 TransXChange Schedules

Rights in the contents of bus schedules encoded as *TransXChange* conformant XML documents are separate from rights in the *TransXChange* Schema itself. Document content is the property of the publisher of each document.

1.3.1.2 TransXChange Document Publisher

TransXChange includes a software tool, the *TransXChange Publisher*, which may be used to transform XML schedules into pdf output. *TransXChange Publisher*, is supplied on a free-to-use licence on an unwarranted, ‘as-is’ basis. The publisher runs under a Java environment (JRE 1.4.2 or higher).

The Publisher may use on-line web services to fetch stop and map data that are incorporated into the published output. The use of stop data and map data in published output is governed by the terms of use of the publisher. In particular the map data may only be used for validating TransXChange documents submitted to the EBSR process, and not for other commercial uses such as publicity material, planning, etc.

1.4 Versioning

A strict versioning system is used for *TransXChange*, following e-Gif principles. This is made explicit in Version 2.0 and is explained in Section 12.1.

1.5 Naming Conventions

Systematic Naming conventions are used for schema elements following the e-Gif guidelines. The conventions are described in Section 8.

1.6 Presentation Conventions Used in the Schema Guide

1.6.1 XML Elements in Text

TransXChange uses the XML Schema Language (See http://www.w3.org/TR/xmlschema-0/, http://www.w3.org/TR/xmlschema-1/ and http://www.w3.org/TR/xmlschema-2/) and its terminology, such as "sequence" and "choice" to formally describe its data structures.

Throughout this *TransXChange* Schema Guide:

- XML elements are shown in bold italic type, for example the ***JourneyPattern*** element.
- XML attributes are shown in bold, for example **MappingSystem**.
- Containment of a subelement by another element is shown by a forward slash, for example ***StopPoint*** / ***AtcoCode***.

1.6.1.1 UML Diagrams

Unified Modelling Language (UML) notation is used for class and instance diagrams to show the formal structure of the *TransXChange* Logical Reference model; the diagrams express structure in terms of classes, connected by association, aggregation and inheritance relationships, corresponding to the semantics available in XML's built-in reference and extension mechanisms. Note that the UML diagrams are provided for explanatory purposes only, and omit an amount of detail (in particular, only a few element properties are typically shown as class attributes, and intermediary elements of a relationship are sometimes omitted.). UML notation uses well known conventions for showing the navigability, multiplicity, etc, of model elements, which we do not repeat here.
Note that in UML structure diagrams we label relationships in the direction of the navigability. Most relationships are navigable in only one direction, indicated by the arrow that points in the direction of navigability, i.e. coming from the entity that holds reference, to the referenced entity.
For *TransXChange, w*e refine the standard UML conventions by the systematic use of colour: in particular:

- Network topology elements are shown in diagrams in *green* (for example, ***Route***, ***StopPoint***).
- Service level and service pattern related elements are shown in *yellow* (for example, ***FlexibleService***, ***JourneyPattern, JourneyPatternTimingLink***).
- Vehicle journey related elements are shown in *orange* (for example, ***VehicleJourney***, ***VehicleJourneyTimingLink***).
- Elements concerned with operational days, dates and times are shown in blue, (for example, ***OperatingProfile***, ***BankHolidays, Frequency***).

1.6.1.2 XML Structure Diagrams

XML Spy (from Altova GmbH) structure diagrams are used extensively in the detailed schema description to illustrate the containment structure of XML schema fragments. Each XML element is shown as a solid box. Use of a complex data type is shown by a dashed box.

Attributes are not shown in the diagrams, but are explained in the accompanying documentation. To indicate the presence of an attribute we use a convention of including the attribute name in the element comment prefixed by an 'at' sign ('@'), for example '@*lang*'. Note that XML Spy diagrams use a slightly different notation from regular UML for multiplicity and optionality.

1.6.1.3 Element Structure – Sequence

The hexagonal symbol with the horizontal line of three dots indicates "sequence of." For example, *Figure 1-1* says the element ***ValidityPeriod*** consists of the sequence of ***StartDate*** followed by ***EndDate***. Both elements are defined in the namespace whose prefix is "*txc*". The adornment of a small series of horizontal lines in their upper left box corners indicates that ***StartDate*** and ***EndDate*** are non-empty elements.

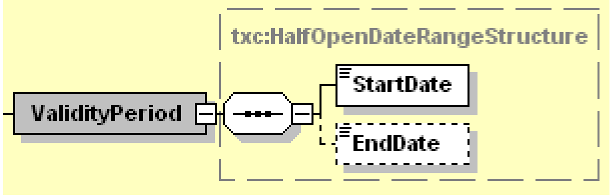


Figure 1-1 – XML Spy Diagram: Sequence

1.6.1.4 Element Structure – Choice

The hexagonal symbol with the switch-like icon indicates a choice. For example in *Figure 1-2* there is a choice between the elements ***NoSubsidy***, and ***Subsidy***. ***Subsidy*** has a further substructure, indicated by a "+" in at the right-hand end. ***NoSubsidy*** is an empty element.

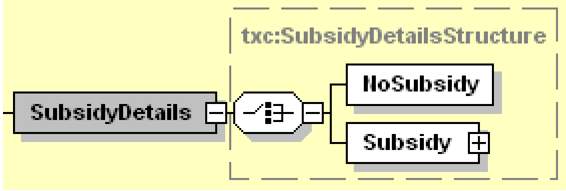


Figure 1-2 – XML Spy Diagram: Choice

1.6.1.5 Multiplicity and Optionality

Whether elements are required or optional, and the multiplicity (cardinality) of elements is indicated by adornments as follows:

- A *fine dashed line* on the connecting line and surrounding box indicates an element is optional. For example, in *Figure 1-3*; ***FlexibleZones*** and ***Description***.
- A *solid line* indicates a mandatory element. For example, in Figure 1-3; ***StopRef.***
- A *number adornment* indicates a multiplicity other than one. 'Many' is indicated by an infinity sign ∞. Thus, for example in *Figure 1-3*, there may be one ***Description,*** but there can be between one and many ***FlexibleZone***, and must be three or more ***Location*** Instances.

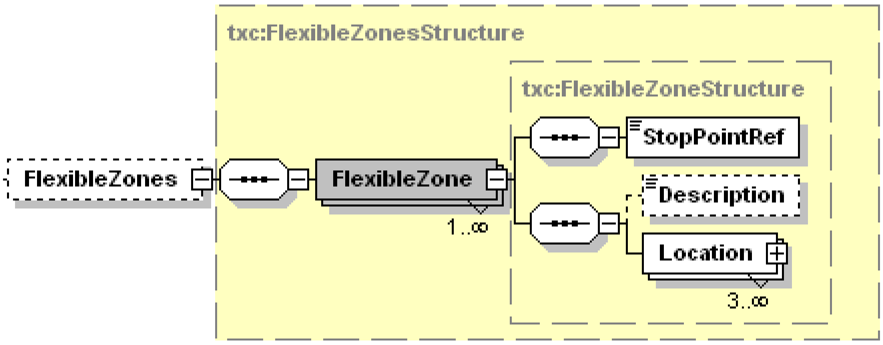


Figure 1-3 – XML Spy Diagram: Multiplicity

1.7 Major Changes in Release 2.0 of TransXChange

TransXChange include major syntactic and semantic revisions to bring it closer to *NaPTAN* and other standards. The following is a summary of major changes in release 2.0. See Section 16 for a full list of changes.

- Modularisation.
- eGif GovTalk compliance.
- Data Integrity improved.
- Welsh Language support added.
- Route Links remodelled.
- VehicleJourney & JourneyPattern model revised for efficiency and integrity.
- Days of Operation standardised and extended.
- Registration Number supported.
- Provision of a full *TransXChange Schema Guide* with examples.
- New *TransXChange Publisher* to transform XML documents to Acrobat pdf format.
- Use of revised *NaPTAN* & *NPTG* models.
- Revision of Registration / Service relationship to enable connecting services to be specified in registrations.

New function for:

- New National Operator code, when available.
- Flexibly Routed Services.
- Vehicle Operations.
- School Dates.
- Fare Stages (but not fares).
- Dead Run support.
- Dynamic Bay Allocation.
- Add further descriptive elements to Service.

For changes in 2.1 see Appendix B.

Note that an extension of *TransXChange* to handle fares information, currently referred as *FareXChange,* is being considered for future development.

1.8 Evolving TransXChange

The extensive changes mandated for *TransXChange 2.0* inevitably mean that strict XML compatibility between documents and tools running at *TransXChange 1.2* is not possible. The intention in *TransXChange 2.0* was to undertake a comprehensive update that aligns it closely to *NaPTAN,* and that will help to minimise changes needed in future. The objective however was to achieve a full upwards compatibility of *data* – the existing content used to create *TransXChange* 1.2 documents should be exactly mappable to the revised schema. Since existing *TransXChange* documents are generated automatically by various suppliers' tools, the enhancement of the tools to generate the new format should provide a straightforward upward migration path.
At the same time, 2.0 put into place a formal versioning method that should aid with the concurrent operation of schemas at different levels in future.

In order to achieve upwards compatibility of data, care has been taken to preserve the existing semantics of *TransXChange*.

Work areas identified for future *TransXChange* work include:

- Fine grained exchange of deltas.
- Further support for multimodal Interchanges (Journey connections between different modes of transport).

1.9 Acknowledgments

This document has been prepared by the Carlbro (Richard Mejia, Paul Robinson) and Kizoom teams (Nick Knowles, Tom White) under direction of Roger Slevin of the Department for Transport, and Tim Hughes (VOSA). Introduction, modelling, structure example, schema and technical sections have been provided by Kizoom, worked examples by Carlbro. We thank Matt Francis of Action Information Management Ltd for his examples, comments and suggestions including the table of comparative terminology. Thanks also to Andrew Cudbertson (Arriva), Ross Dixon (CGEY), Michael Forbes (Opcom), Kieran Holmes (Cap Gemini), Paul Houghton (Trandata), Peter Miller (ACIS), Peter Neil (Trapeze), Mike Ness (WSAtkins), Pete Ridley (Thales), John Prince (SYPTE), John Gallagher (Thales), Stephen Corlett (Thales), Richard Shaw (WSAtkins), Alex Worrel (AtkinsGlobal), Adrian Walters (Infocell), Mary Doonan (Journey Plan), Dave Walter (Anite), Dr Martin Siczkowski (WYPTE), Mike James (Tandata), John Pryer (Omnibus), Wilfred Düx (MDV), Graham Browne (WYPTE), Peter Stoner, and other ATCO,RTIG and PTIC members for their comments, examples and other feedback.

1.10 Related Transport Information Standards

TransXChange is an XML based standard and is compatible with the following standards for public transport information:

- **ATCO-CIF:** ATCO-CIF is a general purpose exchange format for common elements of timetable information. *TransXChange* is intended to be a successor to ATCO-CIF.

- **NaPTAN:** The **National Public Transport Access Nodes** database is a UK nationwide system for uniquely identifying all the points of access to public transport in the UK. The *NaPTAN* database is maintained centrally under contract to the Department for Transport. The *NaPTAN* standard is described in a separate document (see bibliography at end). *NaPTAN* is intended to assign every UK train station, coach terminus, airport, ferry terminal, bus stop, etc, a unique *NaPTAN* identifier. For large interchanges & termini, *NaPTAN* points identify the entrances from the public thoroughfare – one identifier is distinguished as the main entrance.

- **NPTG:** The **National Public Transport Gazetteer** is an auxiliary database to *NaPTAN* that provides a means of relating *NaPTAN* stops to UK towns and villages, as well as to the regional groupings used to manage Public Transport data. *TransXChange* assumes knowledge of the current NPTG database by all parties.

- **Transmodel:** *Transmodel* is an abstract Reference Data model of the data of interest to organisations designing transport related information systems. It has been developed through several European Commission sponsored projects. A pre-standard version 4.0 is expected to be replaced soon by a full CEN standard as v5.1

- **JourneyWeb:** *JourneyWeb* is an XML protocol allowing distributed journey planning. The protocol is a UK national *de facto* standard sponsored by the UK Department for Transport, and is being used in the Transport Direct Portal project to provide contiguous distributed journey planning across the whole of the UK.

- **SIRI:** *Service Interface for Real-time Information* is a standard for the exchange of real time bus information between systems developed by CEN members of the UK Real Time Interest Group. It is also based on *NaPTAN* and *Transmodel,* and will be evolved so as to harmonise with other related standards including *TransXChange*.

- UK **Geocoding** References: For geospatial location references *TransXChange* supports both Grid references – using Eastings and Northings, with support for both UK Mainland and Irish grids – and WGS 84 Latitude and Longitude. However Grid location references must be used for registrations.

1.11 Legislation

Bus registration is covered by several sets of bus registration regulations under the Transport Act 1985. These regulations are: The Public Service Vehicles (Registration of Local Services) Regulations 1986, amended by SI1988 1697, SI1989 1064, SI1993 2752, SI1994 3271 and SI2004 10.

1.12 Related Documents

A TransXChange Registration provides an electronic representation of the following forms issued by the Vehicle and Operating Services Agency (VOSA). The forms may be downloaded in pdf format from http://www.vosa.gov.uk/.

Description	England and Wales	Scotland	Date
Application to Register a Bus Service	PSV350	PSV350 (Scotland)	June 2003
Short Notice Registration Supplementary Form	PSV350A	PSV350A (Scotland)	Sept 2001
Local Bus Service Registration. Guide for Operators	PSV353A		June 2004
Application to Change or Cancel details of a Local Service Registration	PSV355	PSV355A (Scotland)	

Table 1-1 – Forms for Registering Bus Services in England and Scotland

2 OVERVIEW OF TRANSXCHANGE

2.1 The Purpose of TransXChange

TransXChange is a standard format for describing bus routes and schedules as XML documents that can be automatically exported and imported between different computer systems. The documents themselves can be exchanged by different transport mechanisms, for example, FTP, email or http, and can be zipped (compressed) significantly to speed transfer.

There are two main variants of *TransXChange*:

- **Registration schema:** Defines XML documents specifically for the purpose of registering bus services with VOSA. Each document contains a single registered "service".
- **General schema**: Defines XML documents for exchanging bus timetables and related information for many different purposes. Many bus services can be specified in a single document. Partial schedules may be exchanged.

2.2 TransXChange Elements

TransXChange comprises the following main elements:

- *TransXChange Schema*: A model and formal schema for describing and encoding bus schedules as XML documents. The schema can be used with software tools to check that documents are correctly formatted and contain the required content.

- *TransXChange Documents and Process*: A description and explanation of the standard, including rules for creating, managing and using *TransXChange* documents with software tools.

- *TransXChange Publisher*. The publisher is a free tool issued along with *TransXChange,* which allows users to render *TransXChange* XML documents into a readable timetable-like layout, using Acrobat pdf file format. The free Acrobat reader from Adobe can be used to read and print .pdf files. *TransXChange Publisher* requires the installation of a standard open source environment for running Java and XSLT – this can also be downloaded free. Use of these tools is described in Chapter 9. The *TransXChange Publisher* can be run in two modes: for *Registration*, in which case a specific subset of content is published for the registered particulars of a service, and for *General* use, which includes some additional content.

It should be emphasised that *TransXChange* is a data definition standard, and not a software program or a dynamic protocol in itself. It is intended to enable different suppliers and user communities to build systems that can share information correctly, cheaply and efficiently, but does not prescribe detailed error handling or other implementation details that will vary according to the requirements of individual applications.

2.3 Document Validation

To be valid *TransXChange* data, documents must satisfy two levels of validity criteria:

1. **Well-formedness and validity:** Documents must parse and validate against the *TransXChange* schema at the specified level – Registration or General – including

all the integrity constraints coded within the schema, such as for key uniqueness and reference. Any document that does not satisfy the syntactic rules will be rejected for Registration and may not be accepted or understood correctly in uses on the General Schema.

2. **Correctness:** Documents must satisfy additional processing rules and constraints that are not enforceable in the XML of the schema, but which are specified in this document, or as annotations in the schema (In case of any inconsistency, the schema should be regarded as definitive). Typically these rules cover additional complex processing or uniqueness constraints that cannot readily be expressed using XML's built-in mechanisms. Any document that is not correct may be rejected for Registration and may not be accepted or understood correctly in uses on the General Schema. A number of semantic rules are listed later, and a severity assigned to them. The publisher provides a diagnostic function to checks for a number of these errors.

2.4 How is TransXChange Used?

The following three scenarios give the most common uses for *TransXChange*:

(i) To register a complete service.
(ii) To update a registration.
(iii) To exchange service related data for a wide variety of other purposes.

2.4.1 Registration of a Route with VOSA

The most common scenario for use of *TransXChange* is to make a registration (*Figure 2-1*), and runs as follows:

1. Bus schedule data is prepared using scheduling software, including route and stop data.
2. The schedule is exported as a *TransXChange* XML document to VOSA for registration. On export, the document is validated against a specified version of the schema. Note that *TransXChange* documents can also in principle be created by hand, though this would be both tedious and error prone.
3. The schedule is then imported by VOSA and Local Transport Authorities. On import, the document is validated against the version of the schema indicated by the document.
4. Following validation, the registered particulars alone are rendered as a readable pdf document using the Registration option of the *TransXChange* publisher.
5. The schedule is then imported by information system builders such as journey planners and AVL system implementers.
6. All or part of routes and schedules may be exchanged by system providers, annotated with additional operational data, over and above the registered particulars.

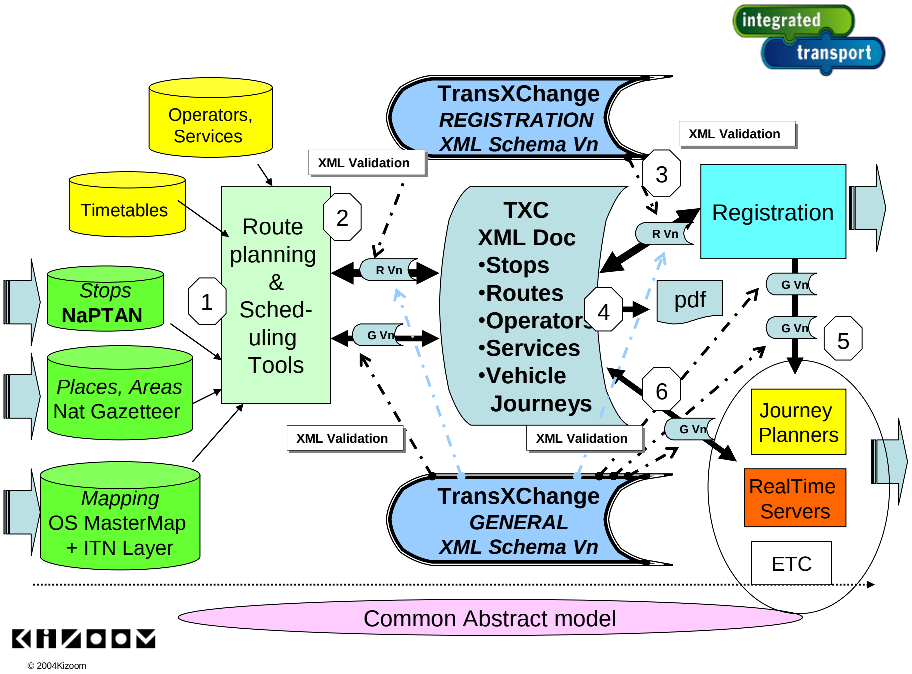

integrated
transport
Operators, Services
Timetables
Stops NaPTAN
Places, Areas Nat Gazetteer
Mapping OS MasterMap + ITN Layer
Route planning & Sched-uling Tools
TransXChange REGISTRATION XML Schema Vn
TransXChange GENERAL XML Schema Vn
XML Validation
XML Validation
XML Validation
XML Validation
TXC XML Doc •Stops •Routes •Operators •Services •Vehicle Journeys
R Vn
R Vn
G Vn
G Vn
G Vn
G Vn
Registration
pdf
Journey Planners
RealTime Servers
ETC
1
2
3
4
5
6
Common Abstract model
© 2004Kizoom

Figure 2-1 – Overview of TransXChange Use

2.4.2 Update of a Registration with VOSA

TransXChange will also be commonly used to update an existing registration.

1. The schedule is updated by the owner using the schedule preparation system.
2. The schedule is reported as an XML registration document with updated data and modified change dates. Note that the whole schedule must be recreated; *TransXChange* does not currently formally support the exchange of 'deltas', that is, changes to just part of a route or timetable (though this is likely to be added in future).
3. The schedule is revalidated and imported by VOSA, and the changed parts are updated in the VOSA database. The validation and propagation process thereafter is as for registration.

2.4.3 General Purpose Exchange of Data

TransXChange can also be used for the general purpose exchange of structured bus schedule data between any two information systems. Normally the *TransXChange G*eneral schema will be used for this purpose, as it allows consistent subsets of data to be exchanged. Example uses might include:

- Exchanging schedule information with journey planning systems that wish to use the service.
- Exchanging route information with mapping systems that wish to draw the route.
- Exchanging schedule and operational data with AVL systems that wish to provide real-time bus predictions.
- Exchanging school term dates with Educational Authorities.
- Exchanging Operator details.

The precise scenario of use will depend on each specific purpose, but may be described generally (*Figure 2-1*), as follows:

- The exporting system will output the desired selection of data into an XML document. The resulting document must validate against the *TransXChange* schema version referenced in the document header.
- The document is transferred from the source to the target system by any appropriate transport method (e.g. email, ftp, and http).
- The importing system validates and imports the document, using the appropriate version of the *TransXChange* schema indicated by the document to interpret the document's contents. It will reject the document if it is not well-formed (including the rules for internal integrity). It may decide its own actions to handling errors in the conforming to application level integrity constraints.

2.5 Differences between the Schemas

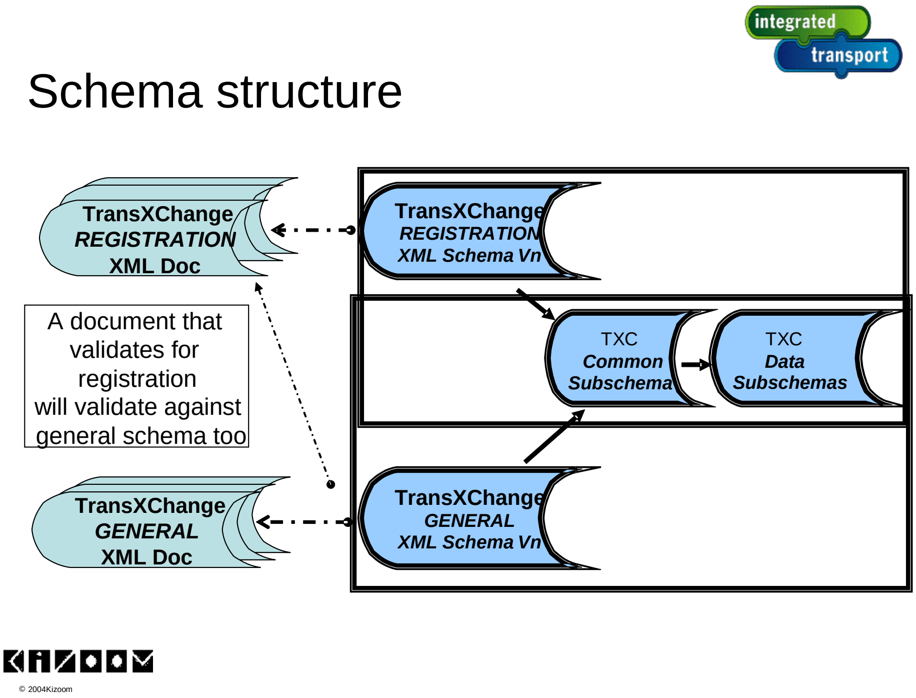
The *TransXChange* ***Registration*** and ***General*** schema are essentially the same, but differ in a few constraints as to cardinality and the required use of certain elements.

Table 2-1 summarises the differences between the two schema variations:

TransXChange **Registration Document**	***TransXChange*** **General Document**
Must have a single ***Registration***.	Can have zero or multiple *Registration* instances.
The ***Registration***. Must reference a primary ***Service*** which describes the service being registered. Other connecting services to which the primary service connects can be included.	May have zero, one or many services.
The ***Service*** for the ***Registration*** must have a fully completed Registered Operator, i.e. of type ***LicensedOperator***.	Registered operator details need not all be completed, i.e. can be of type ***Operator,*** rather than ***LicensedOperator.***
Sufficient information about each stop must be provided to constitute a stand alone definition for statutory purposes.	Simple Stop references may be used.
The ***Route*** information for the registered ***Service*** should include additional mapping point information where appropriate (using the ***RouteLink*** / ***Track*** / ***Mapping*** elements) to make the route unambiguous when the stop and mapping points are followed in sequence over a map containing a road network description.	Mapping information is optional.
Primary ***LocationSystem*** used in a ***Registration*** document must be Grid.	Either WGS84 or Grid can be used for ***LocationSystem***. The same system should be used for all references in a given document.

Table 2-1 – Differences between Schemas

The schemas share a common set of element types (*Figure 2-2*). As a general principle, the *Registration* schema is strictly substitutable with the *General* schema, that is, a valid *Registration* document will always validate against both schemas and can be used wherever a *General* document is used.



Schema structure

A document that validates for registration will validate against general schema too

integrated
transport
TransXChange REGISTRATION XML Doc
TransXChange REGISTRATION XML Schema Vn
TXC Common Subschema
TXC Data Subschemas
TransXChange GENERAL XML Doc
TransXChange GENERAL XML Schema Vn
KIZOOM
© 2004Kizoom

Figure 2-2 – Common Set of Types in TransXChange Schemas

3 SHORT TOUR OF THE *TRANSXCHANGE* ESSENTIAL MODEL

In this chapter, we provide an overview of the logical model underlying the *TransXChange* schemas. Unified Modelling Language (UML) diagrams are used to show the relationships between the most significant elements.

3.1 Representing a Bus Service in *TransXChange*

The *TransXChange* model) has seven basic concepts: ***Service***, ***Registration***, ***Operator***, ***Route***, ***StopPoint***, ***JourneyPattern,*** and ***VehicleJourney***.

A ***Service*** brings together the information about a registered bus service, and may contain two types of component service: Standard or Flexible; a mix of both types is allowed within a single ***Service***.

- A normal bus schedule is described by a ***StandardService*** and a ***Route.*** A ***Route*** describes the physical path taken by buses on the service as a set of route links.
- A ***FlexibleService*** describes a bus service that does not have a fixed route, but only a catchment area or a few variable stops with no prescribed pattern of use.
- A ***StandardService*** has one or more ***JourneyPattern*** elements to describe the common logical path of traversal of the stops of the ***Route*** as a sequence of timing links (see later), and one or more ***VehicleJourney*** elements, which describe individual scheduled journeys by buses over the ***Route*** and ***JourneyPattern*** at a specific time.
- **Route**, **JourneyPattern** and **VehicleJoumey** follow a sequence of *NaPTAN* ***StopPoints***. A ***Route*** specifies in effect an ordered list of ***StopPoints.*** A ***JourneyPattern*** specifies an ordered list of links between these points, giving relative times between each stop; a ***VehicleJourney*** follows the same list of stops at specific absolute passing times. (The detailed timing Link and elements that connect ***VehicleJourneys, JourneyPatterns*** etc to ***StopPoints*** are not shown in *Figure 3-1*).
- Both types of service have a *registered* ***Operator,*** who runs the service. Other *associated* operator roles can also be specified.
- A ***Registration*** specifies the registration details for a service. It is mandatory in the registration schema.

Figure 3-1 shows, in UML class diagram notation, the basic elements of the *TransXChange* schema. Reusable elements with a global scope are organized beneath the root ***TransXChange*** element of the schema by container elements; that is, ***Routes***, ***StopPoints***, ***Services***, ***Operators*** and ***VehicleJourneys***. (Note that this picture is a simplification: for example, there are some other global containers, such as ***ServicedOrganisations*** and ***RouteSections,*** which are not shown.)

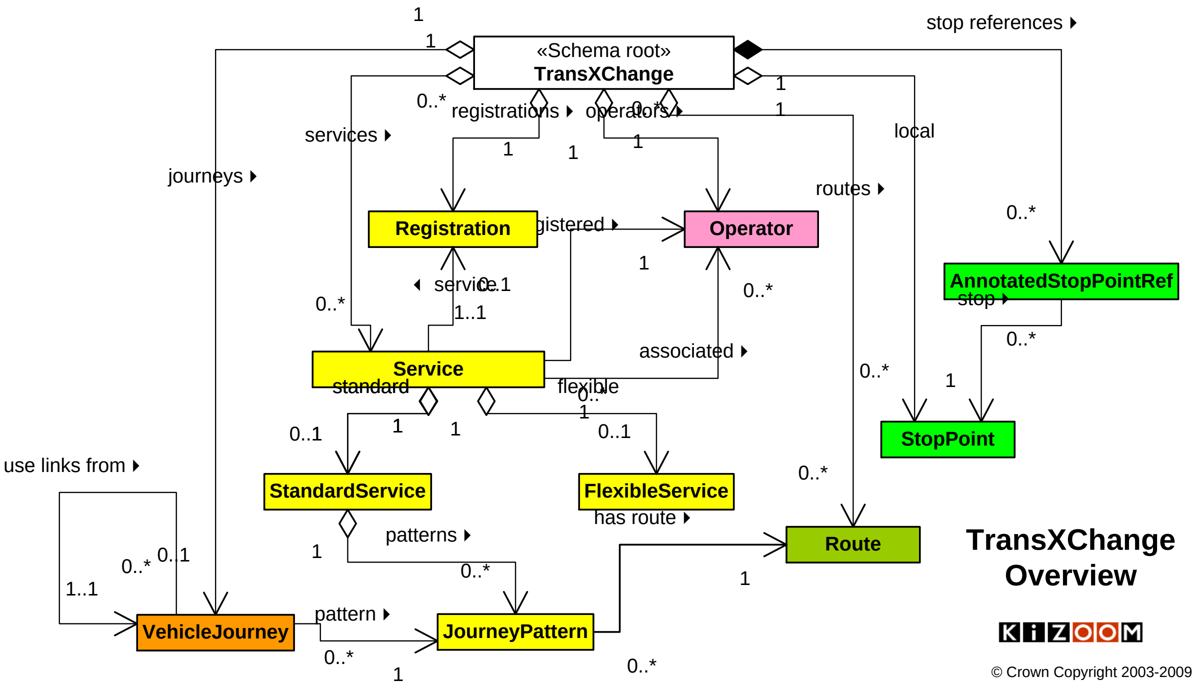


Figure 3-1 – UML Overview of TransXChange Model for a StandardService

Figure 3-2 shows further elements of the TransXChange model.

- A **ServicedOrganisation** can be used to specify a school, works or other organisation served by a service.
- A ***Stop*** may be part of a group of stops making up a ***StopArea***, and may reside in a topographic region specified by an ***NptgLocality***.
- A ***Route*** may be made up of reusable ***JourneyPatternSection.***
- A ***JourneyPattern*** may be made up of reusable ***JourneyPatternSections***.
- A registration may be accompanied by ***SupportingDocuments***.

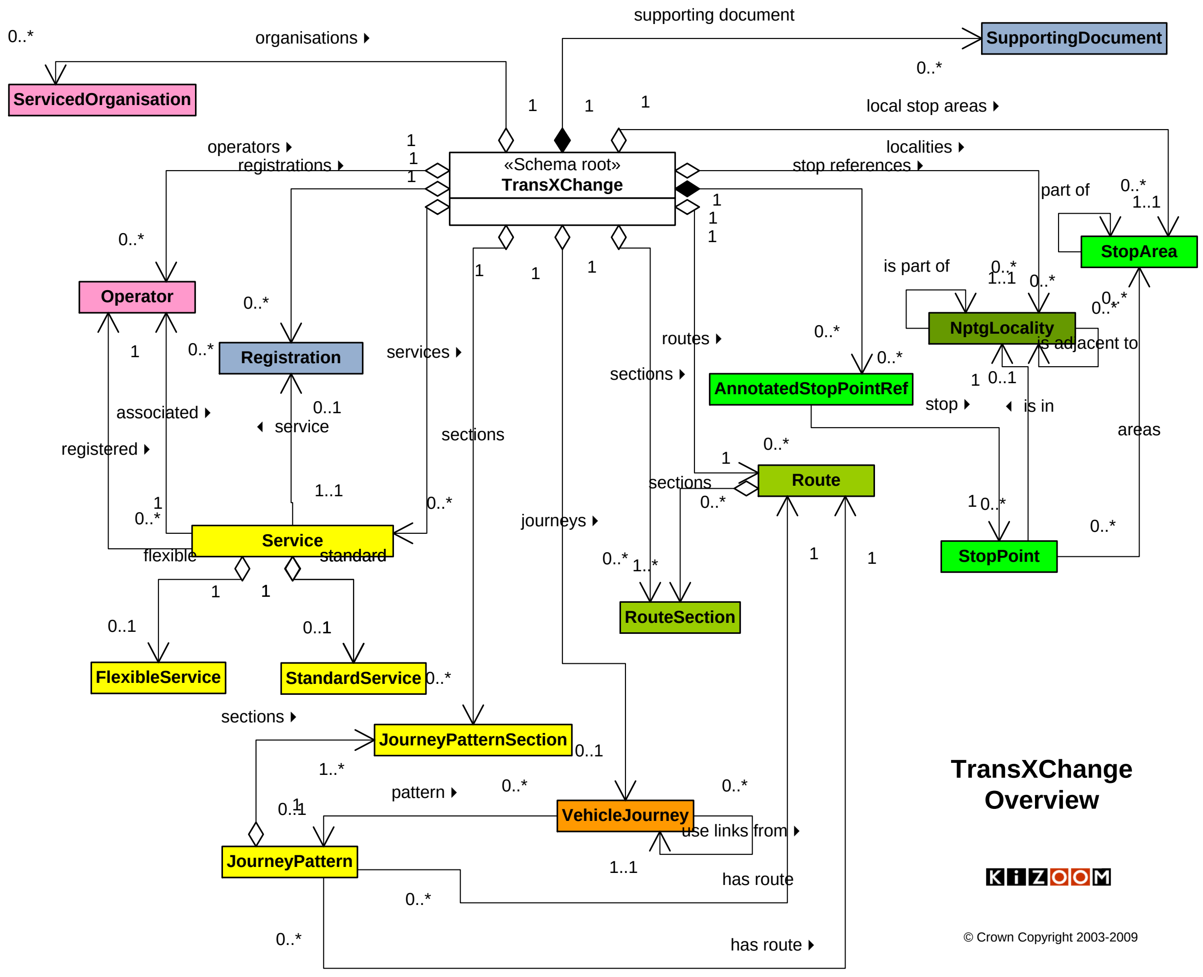


Figure 3-2 – UML Diagram of Elaboration of TransXChange model

3.2 The NaPTAN Stop Model

TransXChange uses the *NaPTAN* stop model to define the stops and timing points of routes, and to associate stops with topographical locations in the National Public Transport Gazetteer (*NPTG*). For further details refer to the '*NPTG and NaPTAN Schema Guide*'. Normally in *TransXChange,* stops comprise just a reference to an existing *NaPTAN* definition using a stop code; all such references are declared as ***AnnotatedStopPointRef*** instances. However, full ***StopPoint*** definitions for new bus stops may also be provided locally in a *TransXChange* document, using the *NaPTAN* **StopPoint** elements within the document. Each new locally defined stop definition must be allocated a *NaPTAN* identifier (that is an ***AtcoCode***) that can be used to reconcile them with the *NaPTAN* database later. Stops are described using three main elements:

Figure 3-3 summarises, in UML class diagram notation, the main stop elements of the *TransXChange* schema.

- ***StopPoint***: Describes a stop, it contains a place, which is used to associate the stop with an ***NptgLocality:*** localities are defined in the *NPTG* database and are open to the Local Transport Authority to edit. Stops may be of a number of different types and subtypes, each with different properties.
  - ***OnStreet / Bus:***
    - ***MarkedStop. UnmarkedStop, HailAndRideSection, FlexibleZone.***
  - ***OffStreet / BusAndCoach***
    - ***Bay, VariableBay.***
- ***StopArea***: Used to group stops together.
- ***NptgLocality***: Representing a topographical locality in the country, such as a city, town or village. Localities must exist in the *NPTG* database. Used to specify where a ***StopPoint*** or ***StopArea*** is relative to towns and cities.
- ***AdministrativeArea***. All NaPTAN and NPTG elements are assigned to an administrative areas – this represents the organisation responsible fro maintaining the stop data. See NaPTAN schema guide for further details.

StopPoints may be declared as either a ***StopPoint,*** or ***AnnotatedStopPointRef,*** indicating that further details may be found in the NaPTAN database. The latter is the normal mechanism.

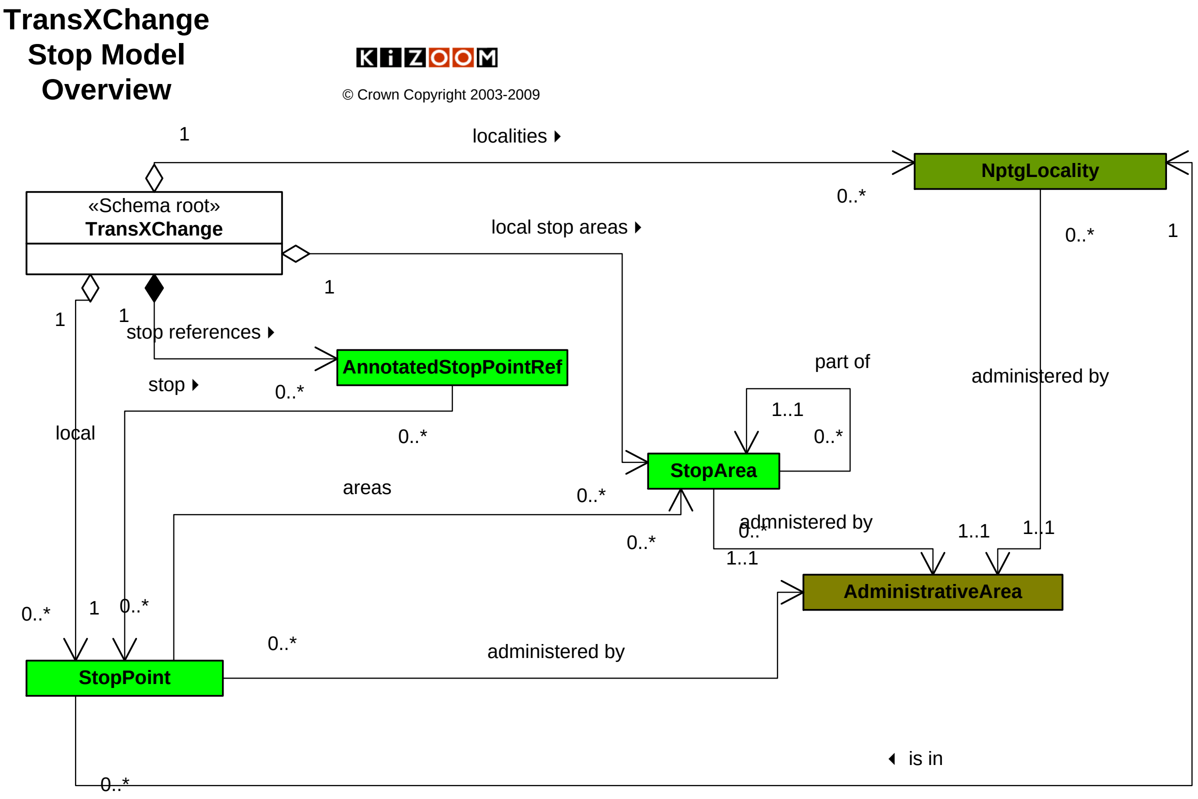


Figure 3-3 – UML Diagram of Summary of Stop Model

Figure 3-4 shows further details of the NaPTAN stop elements. A StopPoint definition includes a ***Place*** & ***Descriptor*** groups. A ***StopAvailability*** may specify when a stop is available.

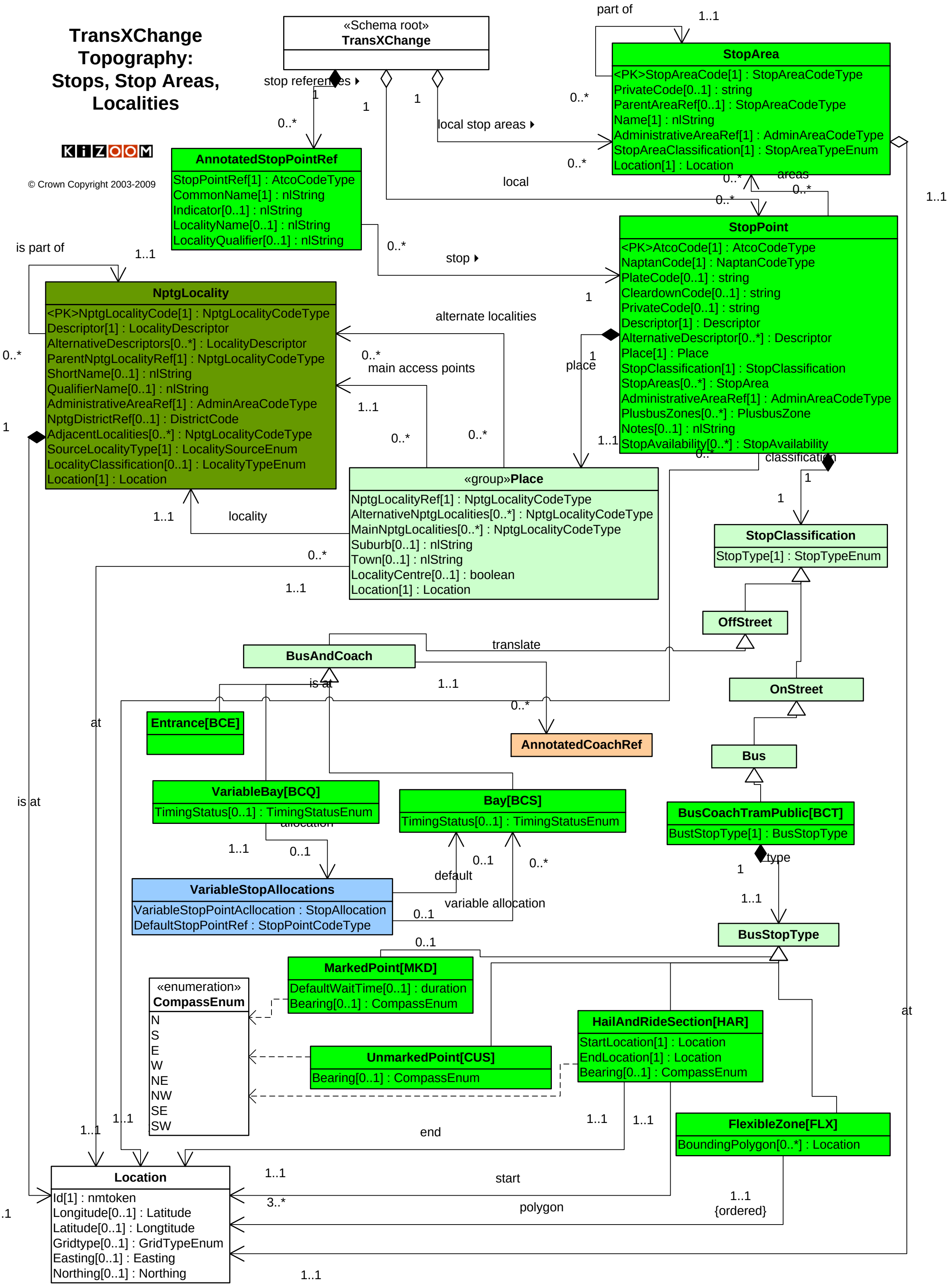

TransXChange Topography: Stops, Stop Areas, Localities
KIZOOM
© Crown Copyright 2003-2009
«Schema root» TransXChange
stop references
1
0..*
1
1
local stop areas
0..*
part of
1..1
StopArea
<PK>StopAreaCode[1] : StopAreaCodeType
PrivateCode[0..1] : string
ParentAreaRef[0..1] : StopAreaCodeType
Name[1] : nlString
AdministrativeAreaRef[1] : AdminAreaCodeType
StopAreaClassification[1] : StopAreaTypeEnum
Location[1] : Location
0..*
local
areas
0..*
0..*
0..*
1..1
AnnotatedStopPointRef
StopPointRef[1] : AtcoCodeType
CommonName[1] : nlString
Indicator[0..1] : nlString
LocalityName[0..1] : nlString
LocalityQualifier[0..1] : nlString
0..*
stop
StopPoint
<PK>AtcoCode[1] : AtcoCodeType
NaptanCode[1] : NaptanCodeType
PlateCode[0..1] : string
CleardownCode[0..1] : string
PrivateCode[0..1] : string
Descriptor[1] : Descriptor
AlternativeDescriptor[0..*] : Descriptor
Place[1] : Place
StopClassification[1] : StopClassification
StopAreas[0..*] : StopArea
AdministrativeAreaRef[1] : AdminAreaCodeType
PlusbusZones[0..*] : PlusbusZone
Notes[0..1] : nlString
StopAvailability[0..*] : StopAvailability
is part of
1..1
NptgLocality
<PK>NptgLocalityCode[1] : NptgLocalityCodeType
Descriptor[1] : LocalityDescriptor
AlternativeDescriptors[0..*] : LocalityDescriptor
ParentNptgLocalityRef[1] : NptgLocalityCodeType
ShortName[0..1] : nlString
QualifierName[0..1] : nlString
AdministrativeAreaRef[1] : AdminAreaCodeType
NptgDistrictRef[0..1] : DistrictCode
AdjacentLocalities[0..*] : NptgLocalityCodeType
SourceLocalityType[1] : LocalitySourceEnum
LocalityClassification[0..1] : LocalityTypeEnum
Location[1] : Location
0..*
1
alternate localities
0..*
main access points
1..1
0..*
0..*
1
place
1
1..1
0..*
classification
1
1
«group»Place
NptgLocalityRef[1] : NptgLocalityCodeType
AlternativeNptgLocalities[0..*] : NptgLocalityCodeType
MainNptgLocalities[0..*] : NptgLocalityCodeType
Suburb[0..1] : nlString
Town[0..1] : nlString
LocalityCentre[0..1] : boolean
Location[1] : Location
1..1
locality
0..*
1..1
StopClassification
StopType[1] : StopTypeEnum
OffStreet
translate
BusAndCoach
is at
1..1
0..*
OnStreet
at
Entrance[BCE]
AnnotatedCoachRef
Bus
is at
VariableBay[BCQ]
TimingStatus[0..1] : TimingStatusEnum
allocation
Bay[BCS]
TimingStatus[0..1] : TimingStatusEnum
BusCoachTramPublic[BCT]
BustStopType[1] : BusStopType
type
1
1..1
1..1
0..1
0..1
default
0..*
variable allocation
VariableStopAllocations
VariableStopPointAcllocation : StopAllocation
DefaultStopPointRef : StopPointCodeType
0..1
0..1
BusStopType
MarkedPoint[MKD]
DefaultWaitTime[0..1] : duration
Bearing[0..1] : CompassEnum
«enumeration» CompassEnum
N
S
E
W
NE
NW
SE
SW
UnmarkedPoint[CUS]
Bearing[0..1] : CompassEnum
HailAndRideSection[HAR]
StartLocation[1] : Location
EndLocation[1] : Location
Bearing[0..1] : CompassEnum
at
FlexibleZone[FLX]
BoundingPolygon[0..*] : Location
1..1
1..1
1..1
1..1
end
Location
Id[1] : nmtoken
Longitude[0..1] : Latitude
Latitude[0..1] : Longtitude
Gridtype[0..1] : GridTypeEnum
Easting[0..1] : Easting
Northing[0..1] : Northing
1..1
start
3..*
polygon
1..1
{ordered}
1..1
1..1

Figure 3-4 – UML Diagram of NaPTAN Stop elements for buses

3.2.1 Resolving NaPTAN Stop References

When importing *TransXChange* schedules, an importing application will normally attempt to find the ***StopPoint*** details in the *NaPTAN* database using the NaPTAN identifier, i.e. the ***AtcoCode***, and if found may - depending on the application's purpose - use the database's definition of the stop details in preference to any local definitions. Only if no existing ***StopPoint*** definition is found, will the locally declared definition be used. See *Table 3-1.*

TransXChange Document use of stop	**NaPTAN database**	
	Exists	**Does not exist**
NaPTAN StopPointRef	Resolve to *NaPTAN*	Error
Local *NaPTAN* declaration	Resolve to *NaPTAN*	Use Local definition

Table 3-1 – Resolving Stop References

3.2.2 Variable Stop Allocations

For bus stations where the allocation of stops may vary over time, *TransXChange* supports variable stop allocation. In such cases the journey pattern should reference a *NaPTAN* stop of type BCQ, representing an unspecified stop or bay within the bus station, and then also specify a schedule of allocations to individual bays (i.e. *NaPTAN* stops of type BCT) for a given date, using the ***VariableStopAllocations*** element.

3.2.3 Stop Types

Every NaPTAN ***StopPoint*** has a stop type that indicates its mode and nature, for example, "*on street, bus stop, marked* ". *Figure 3-5* shows, in UML class diagram notation, the stop classification elements of the *NaPTAN* schema. The main items of interest for TransXChange are:

- **OffStreet/BusAndCoach**, for stops in coach stations
- **OnStreet/Bus** for stops on the street

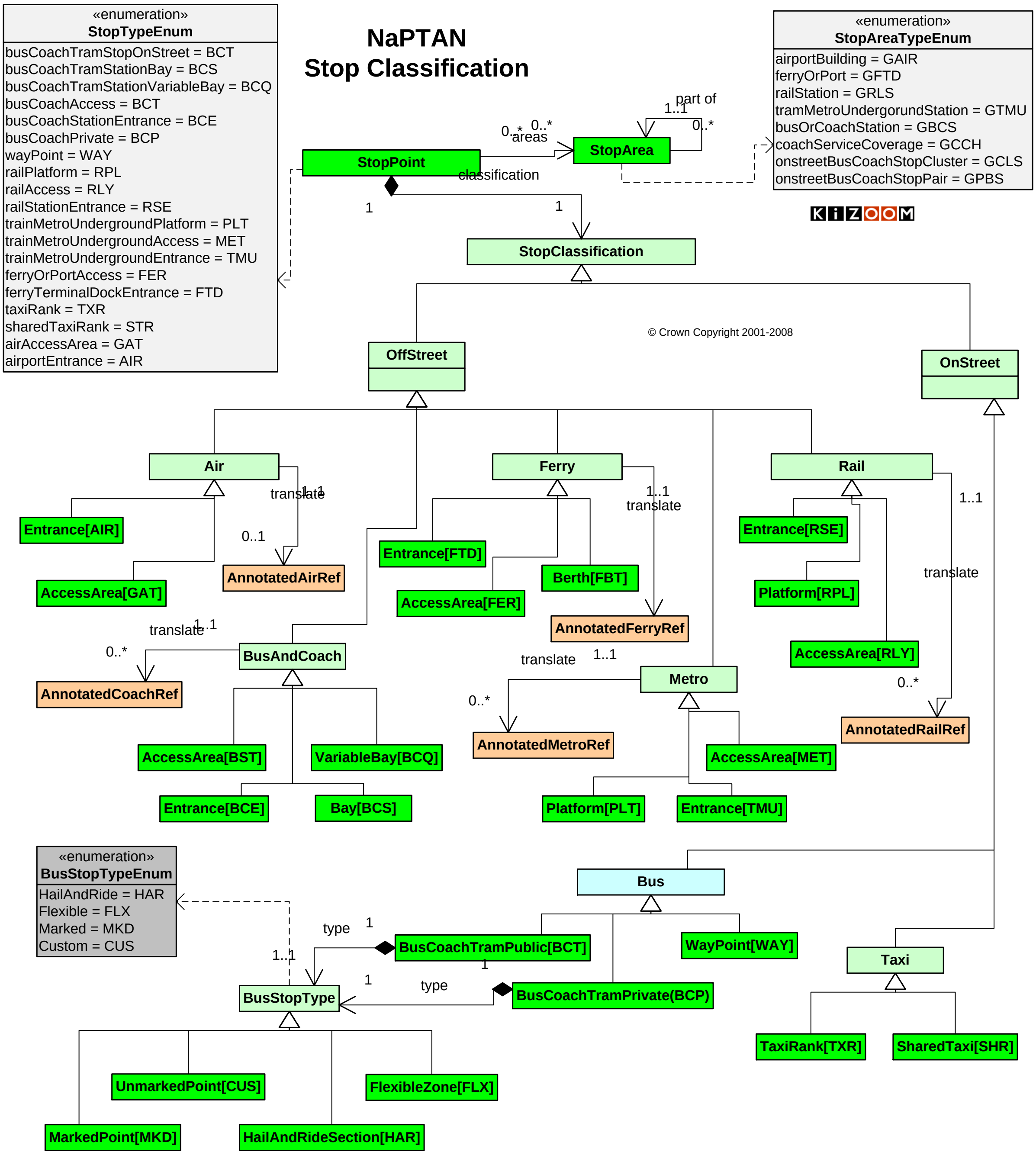


Figure 3-5 – UML Diagram of Stop Classification Model

3.3 The Route and Service Supply Model

TransXChange describes a bus service using a model made up of three distinct layers or 'levels of discourse' (see *Figure 3-6* for an UML diagram):

1. A ***Route***; described as a sequence of route links connecting individual stops. For *TransXChange,* all stops are defined as being *NaPTAN* points, so a route describes a path in '*NaPTAN* space'; a distinct frame of reference made up of Public Transport Access Nodes (PTANs), which is semantically distinct from any given coordinate system, but which can be projected onto geospatial coordinate systems and mapping layers using ***Track*** elements.
   - ***Track*** elements record both the plot of the route at non-*NaPTAN* points, and associations with mapping layer identifiers, such as OS TOIDS.
   - The ***RouteLink*** instances are grouped using a ***RouteSection***, allowing the reuse of whole sequences of links in different routes.

2. A ***JourneyPattern***: a path over the route made up of a number of journey pattern timing links, each with timing information (and other optional operational data) ascribed to them. All timing information is relative (for example, *'+5 minutes'*).
   - Each end of a ***JourneyPatternTimingLink*** can have stop usage information associated with it on a ***JourneyPatternStopUsage*** element, specifying the activity at stop, and other service information.
   - The timing links are grouped using a ***JourneyPatternSection***, allowing the reuse of whole sequences of links in different patterns.
   - The links of a ***JourneyPattern*** must traverse the same stops in the same sequence as the links of any ***Route*** associated with the ***JourneyPattern***. However a ***JourneyPattern*** need not cover the whole ***Route***; it may project onto just a contiguous subset of the links of the route, omitting route links at either or both ends.

3. A ***VehicleJourney***: a traversal of a specific journey pattern at a specific time: again modelled as a sequence of timing links connecting *NaPTAN* stops, using ***VehicleJourneyTimingLink*** and ***VehicleJourneyStopUsage*** elements.
   - Each vehicle journey has an absolute start time (e.g. *'13:02'*) specified: this can be combined with the timing information from each timing link to derive the actual passing times of departure and arrival at each timing point.
   - The public identifier of a ***VehicleJourney*** is given by a ***Line***. One or more ***Line*** instances may be associated with a service, and a ***VehicleJourney*** must reference one of its service's lines.
   - The link sequence of a ***VehicleJourney*** must exactly correspond to the link sequence of the underlying ***JourneyPattern***; that is, each ***VehicleJourneyTimingLink*** must project onto a corresponding ***JourneyPatternTimingLink***.

The *Transmodel* principles underlying the *TransXChange* Route and Service Supply model are summarised in Section 13.1, and divergences from Transmodel usage are listed.

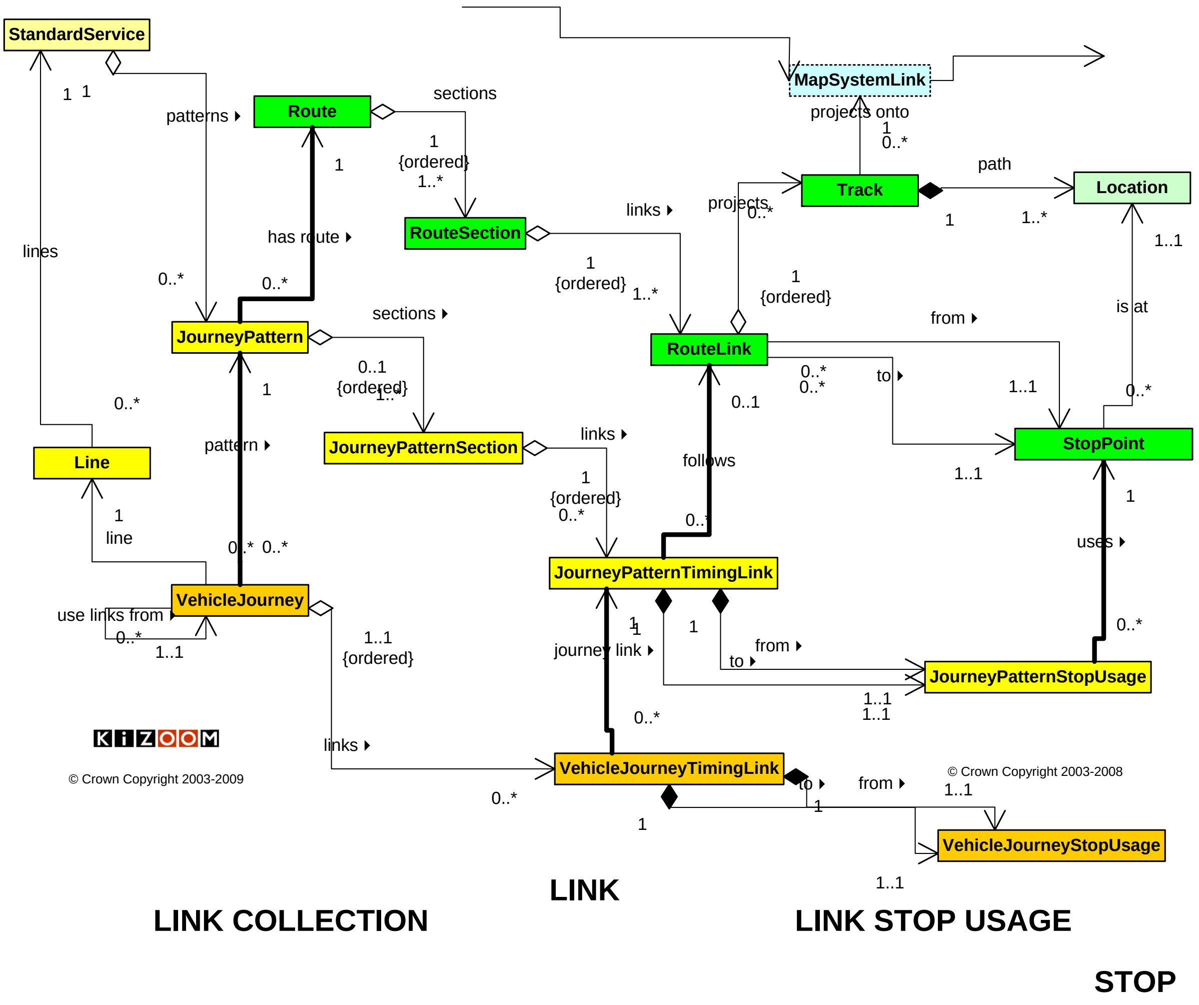


Figure 3-6 – UML Diagram of Route, JourneyPattern and VehicleJourney Models

3.3.1 Model Layer Concerns

Figure 3-7 illustrates how the each layer has a separate concern of the model:

1. The ***Route*** describes the stops, stop sequence, and the physical track between them.
2. The ***JourneyPattern*** adds in timing information; how long each link takes to run, how long to wait at each stop, and the allowed activities at each stop.
3. A ***VehicleJourney*** specifies a start time: this is used to compute actual passing times for each stop in the journey pattern, taking into account the run and waiting times. The vehicle journey can override the run time, wait time and activity from the journey pattern values for its own journey, but not change the stop sequence.
4.

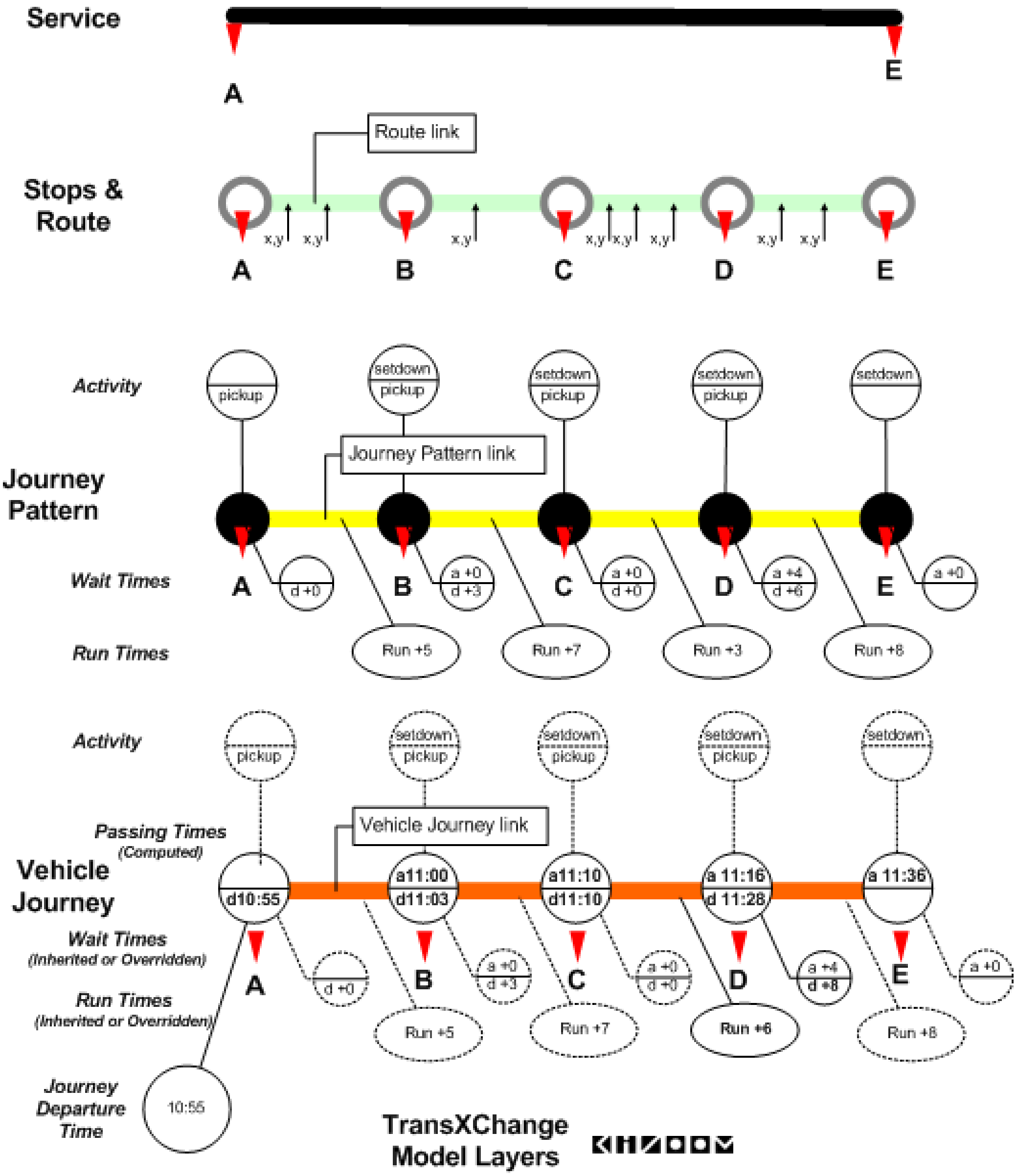


Figure 3-7 – Service Model Layer Concerns

3.3.2 Summary of Route & Supply Model Elements

Each of the three layers is made up of three sets of broadly equivalent elements:

(i) Ordered collections, i.e. sequences, of links (*Patterns* and *Sections*).
(ii) Links (Route *Links* and Timing *Links*).
(iii) Link ends (*Stop Usages*).

Table 3-2 summarises the route and supply model elements, showing the simple one-to-one correspondences between equivalent elements in the different layers. The simple correspondence makes it straightforward to project between the route, journey pattern and vehicle journey layers. There are explicit references between elements in the pattern and link columns, which can be used to derive an implicit projection of the section and stop usage.

Ordered Link Sequence		**Link**	**Link end**
Pattern	(Section)	Link	Stop Usage
Route	***RouteSection***	***RouteLink***	***StopReference***
(AbstractJourneyPattern)	**-**	***AbstractTimingLink***	***AbstractStopUsage***
JourneyPattern	***JourneyPatternSection***	***JourneyPatternTimingLink***	***JourneyPatternStopUsage***
VehicleJourney	**-**	***VehicleJourneyTimingLink***	***VehicleJourneyStopUsage***

Table 3-2 – Correspondence between Links and Nodes

3.3.3 Projection between Levels of Discourse

Figure 3-8 shows a schematic example of links at different levels of discourse and the correspondences between them.

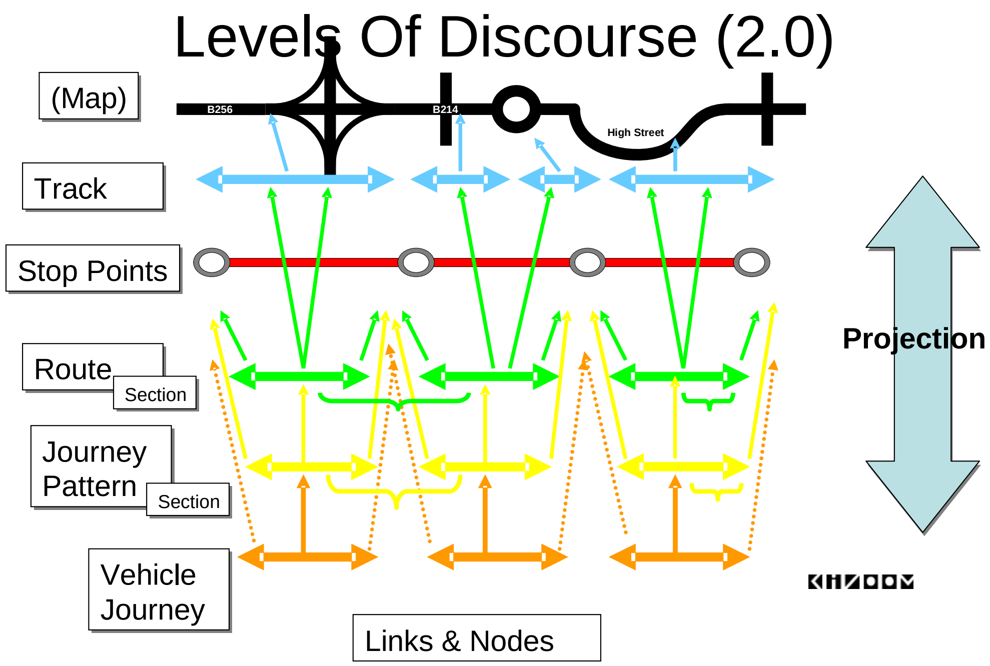


Figure 3-8 – Correspondence between Links at Different Levels

3.3.4 The Use of Links in TransXChange

In *Transmodel*, a journey can be regarded either as an ordered list of stops, or as an ordered list of links between the stops: both views can be derived from the underlying *TransXChange* representation of a journey pattern and vehicle journey as a list of timed links. In *TransXChange,* a 'timing link in link sequence' representation is used (see discussion of *Transmodel* terminology and concepts in section 13.2), as this holds more information than a simple stop list, and can be projected exactly onto a spatial route; it can readily be transformed by applications into a list of stops and passing times if needed.

The following *Transmodel* principles apply to the use of journey patterns in *TransXChange:*

1. *There should be a separate journey pattern for each physical route followed*, i.e. a sequence of timing links between stops defining a unique sequence of stops.

2. *A vehicle journey must always follow a journey pattern*.

3. *A vehicle journey must visit all the stops of a journey pattern*, with two qualifications (which are not strictly *Transmodel -* see 13.2*)*:
    a. **Short working** of the underlying journey pattern is allowed, i.e. truncation of one or more stops at either or both ends.
    b. **Express journeys** over a service pattern are allowed – i.e. provided a journey traverses a link and goes past a stop, it may specify an activity of '*pass'* to omit a particular stop.

The following further principles apply to the use of links to represent journey patterns in *TransXChange:*

4. A vehicle journey *need specify explicitly only those timing links that are different from the underlying journey pattern.* Other vehicle journey links may be *implicit*, that is derived automatically from the underlying journey pattern. In many cases, no *explicit* concrete links need be specified in a vehicle journey.

5. *A vehicle journey may reference all the links of another vehicle journey. In this case all the link usage must be implicit,* that is, all of the links of the referenced journey are used with the same values as in the referenced journey. If the vehicle journey needs to make modifications to links or link properties, it should be based directly on an underlying journey pattern, and not reference another vehicle journey for some links and make further changes.

6. Timing links may have a number of different '*successive'* properties that change over successive steps of the journey pattern, for example, destination headings, duty crews, and fare stages. The properties may be set on individual links at both the journey pattern and vehicle journey level. *Once a successive property (*such as a dynamic destination heading*) is set on a specific link (*or individual link end*), it is considered to be in effect on successor links in the journey until any different value is encountered on a subsequent link.* Link values on successor vehicle journey links may either be set explicitly, or be inherited from a parent journey pattern link.

3.3.5 Structure Example of a Schedule with one Pattern and Two Journeys,

Figure 3-9 shows a simple route, with five stops connected by four links.

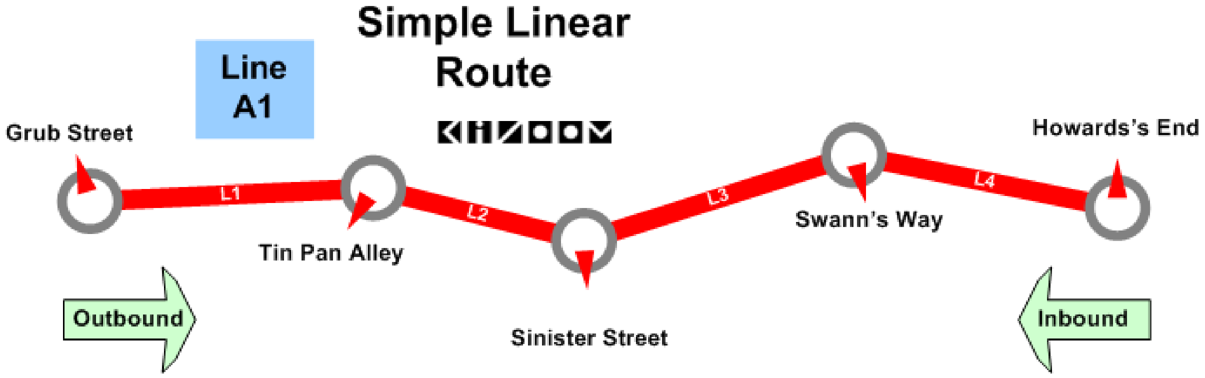


Figure 3-9 – Simple Route Map

Table 3-3 shows an example timetable of a service running over the route, with two vehicle journeys running between each of the five stops.

Name\Line		A1	A1
Grub Street	d	8:02	10:02
Tin Pan Alley	d	8:12	10:12
Sinister Street	d	8:37	10:37
Swans Way	d	8:45	10:45
Howard's End	a	8:55	10:55

Table 3-3 – Structure Example of a Schedule

Table 3-4 shows this same timetable annotated with the XML element instances needed to represent it in a *TransXChange* XML document.

- The service has a single Line *Ln_1* with a Line Name of '*A1*'.
- The service is presented in a matrix of five rows of stops (*S_1 – S_5*), and two columns of journeys (#1 – #2), each column showing a vehicle journey stopping at each row.
- There is one **route** (*R_1*), with a single **route section** (*RS_1*) of four **route links** (*RL_1*, *RL_2, RL_3, and RL_4*). Each route link has two stop references (*RL_1a, RL1b*, etc).
- The service is made up of a single **journey pattern** (*JP_1*). The journey pattern, section and timing links correspond to those of the route; there is a single **journey pattern section** (*JS_1*), and four **timing links** (*JL_1, JL_2, JL_3, JL_4*), with individual **run times** of *10, 20, 8*, and *10* minutes respectively. \There is also a 5 minute wait at sinister street.
  - Each **journey pattern timing link** has two **stop usages** (*JL_1a, JL_1b*, etc), one for each end of the link, i.e. on for departure, one for arrival. These can hold information about the use of the stop
- There are two **vehicle journeys** (*VJ_1, VJ_2*), that both use the same journey pattern, and that are for the same line, '*A1*' (*Ln_1*).
  - For *VJ_1,* each of the four vehicle journey timing links (*VL_1, VL_2, VL_3, VL_4*) corresponds to a link of the journey pattern, and has its own pair of **stop usages** (*VL_1a, VL_1b*, etc).
  - Times at each stop are computed from the vehicle journey **start time** (e.g. '*8.02*') and the individual link **run times** (e.g. +10mn), plus any **wait time** on the stop usage. (For *S_1 – S_4*, only departure times are actually shown in *Table 3-4***;** for *S_5* it is the arrival time).

- The second vehicle journey *VJ_2* reuses the links of the first journey pattern *VJ_*, with a different start time (‘*10:02*’).

									Journeys	
SV_1	**Service**								**#1**	**#2**
					Line				Ln_1	Ln_1
	Route		**Journey Pattern**						JP_1	JP_1
	R_1		JP_1		**Vehicle Journey**				VJ_1	VJ_2
	Route Section		**Section**		VJ_1		VJ_2	Name\Line	**A1**	**A1**
Stop	RS_1		JPS_1		8:02		10:02			
	Link	Ref	Link	Usage	Link	Usage	Link			
S_1	RL_1	RL_1a	JL_1	JL_1a	VL_1.	VL_1a	←	**Grub Street**	8:02	10:02
S_2		RL_1b	+10mn	JL_1b		VL_1b		**Tin Pan Alley**		
	RL_2	RL_2a	JL_2	JL_2a	VL_2	VL_2a	←		8:12	10:12
S_3		RL_2b	+20mn	JL_2b Wait +5mn		VL_2b		**Sinister Street**		
	RL_3	RL_3a	JL_3	JL_3a	VL_3	VL_3a	←		8:37	10:37
S_4		RL_3b	+08mn	JL_3b		VL_3b		**Swans Way**		
	RL_4	RL_4a	JL_4	JL_4a	VL_4	VL_4a	←		8:45	10:45
S_5		RL_4b	+10mn	JL_4b		VL_4b		**Howard’s End**	8:55	10:55

Table 3-4 – Structure Example of Schedule: Shared Journey Pattern

3.3.6 Structure Example of a Schedule with an Express Journey

As a slight variation on the structure example given above, we consider a second example (*Table 3-5*), in which the second vehicle journey (*VJ_3*) omits a particular stop *(S_2*) in the same journey pattern (*JP_1*).

- The second journey declares its own distinct set of vehicle journey timing links (*VL_3_1, VL_3_2, VL_3_3, and VL_3_4*) for the journey, so that it can modify the activity. These are based on the same journey pattern.
- For the stop that is omitted (*S_2*), an override value of ‘pass’ is specified for the activity on the vehicle journey stop usage of the link ends which connect to the stop (*VL_3_1b, VL_3_2a*).

									Journeys	
SV_1	**Service**								**#1**	**#2**
					Line				Ln_1	Ln_1
	Route		**Journey Pattern**						JP_1	JP_1
	R_1		JP_1		**Vehicle Journey**				VJ_1	VJ_3
	Route Section		**Section**		VJ_1		VJ_3	Name\Line	**A1**	**A1**
Stop	RS_1		JPS_1		8:02		10:02			
	Link	Ref	Link	Usage	Link	Usage	Usage			
S_1	RL_1	RL_1a	JL_1	JL_1a	VL_1_1	VL_1_1a	VL_3_1a	**Grub Street**	8:02	10:02
S_2		RL_1b	+10mn	JL_1b		VL_1_1b	VL_3_1b	**Tin Pan Alley**		pass
	RL_2	RL_2a	JL_2	JL_2a	VL_1_2	VL_1_2a	VL_3_2a		8:12	pass
S_3		RL_2b	+20mn	JL_2b		VL_1_2b	VL_3_2b	**Sinister Street**		
	RL_3	RL_3a	JL_3	JL_3a	VL_1_3	VL_1_3a	VL_3_3a		8:32	10:32
S_4		RL_3b	+08mn	JL_3b		VL_1_3b	VL_3_3b	**Swans Way**		
	RL_4	RL_4a	JL_4	JL_4a	VL_1_4	VL_1_4a	VL_3_4a		8:40	10:40
S_5		RL_4b	+10mn	JL_4b		VL_1_4b	VL_3_4’b	**Howard’s End**	8:50	10:50

Table 3-5 – Structure Example of Schedule: Express VehicleJourney

3.3.7 An Instance Example

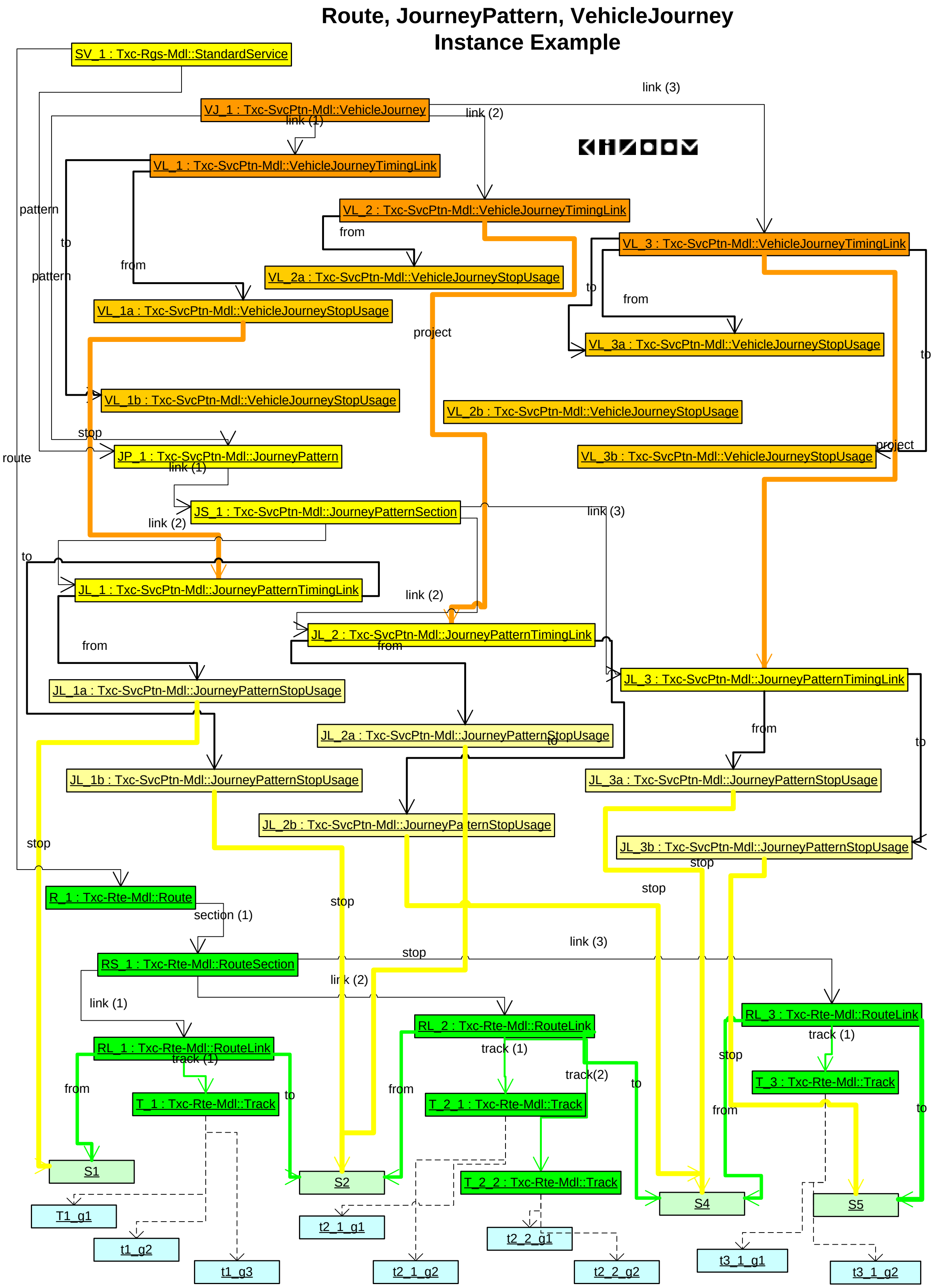
As a pictorial example, *Figure 3-10* shows a UML instance diagram of the element instances for a simple journey with four stops, organized according to their different levels of discourse.

- At the bottom, in green, can be seen a ***RouteSection*** with three ***RouteLink*** instances between the stops, one of which has two ***Track*** instances. The other two have a single ***Track*** Instance. Each Track instance has a ***Mapping***, a sequence of points plotting the line of the route.
- Above this, in yellow, can be seen the ***JourneyPatternSection***, with three ***JourneyPatternTimingLink*** instances which individually project onto the appropriate route links by virtue of pairs of ***JourneyPatternStopUsage*** elements that reference the same stops in the same order as the route links. (Note that an explicit route link-to-timing link reference can also be included in order to avoid ambiguity in circular and other routes with complex topologies – this is not shown).
- At the top, in orange, can be seen the ***VehicleJourney***, also made up of three links. Each ***VehicleJourneyTimingLink*** individually projects onto the appropriate ***JourneyPatternTimingLink*** links by an explicit link reference. Each end of each ***VehicleJourneyTimingLink*** has a ***VehicleJourneyStopUsage*** with which to specify any usage values that are different from that of the journey pattern. The stops of a vehicle journey timing link may not be different from those of the corresponding journey pattern timing link, so are inherited from the journey pattern link, rather than being explicitly referenced.

3.3.8 Plotting a route on a Map

If ***Track*** data is present it can be used to plot an exact route track on a map. In this case the ***Mapping*** data should be regarded as independent of the stop locations. That is to plot a route the last point of each mapping is connected to the first point of the succeeding ***Mapping.*** for example, in *Figure 3-10* the route plot is given by

(t1_g1 — t1_g2 — t1_g3) — (t2_1_g1 — t2_1_g2) — (t2_2_g1 — t2_2_g2) — (t3_g1 — t3_g2)



Route, JourneyPattern, VehicleJourney Instance Example

SV_1 : Txc-Rgs-Mdl::StandardService
VJ_1 : Txc-SvcPtn-Mdl::VehicleJourney
link (1)
link (2)
link (3)
VL_1 : Txc-SvcPtn-Mdl::VehicleJourneyTimingLink
VL_2 : Txc-SvcPtn-Mdl::VehicleJourneyTimingLink
VL_3 : Txc-SvcPtn-Mdl::VehicleJourneyTimingLink
VL_2a : Txc-SvcPtn-Mdl::VehicleJourneyStopUsage
VL_1a : Txc-SvcPtn-Mdl::VehicleJourneyStopUsage
VL_3a : Txc-SvcPtn-Mdl::VehicleJourneyStopUsage
VL_1b : Txc-SvcPtn-Mdl::VehicleJourneyStopUsage
VL_2b : Txc-SvcPtn-Mdl::VehicleJourneyStopUsage
VL_3b : Txc-SvcPtn-Mdl::VehicleJourneyStopUsage
pattern
to
pattern
from
from
to
from
project
to
project
stop
route
JP_1 : Txc-SvcPtn-Mdl::JourneyPattern
link (1)
JS_1 : Txc-SvcPtn-Mdl::JourneyPatternSection
link (2)
link (3)
to
JL_1 : Txc-SvcPtn-Mdl::JourneyPatternTimingLink
link (2)
JL_2 : Txc-SvcPtn-Mdl::JourneyPatternTimingLink
from
from
JL_3 : Txc-SvcPtn-Mdl::JourneyPatternTimingLink
JL_1a : Txc-SvcPtn-Mdl::JourneyPatternStopUsage
JL_2a : Txc-SvcPtn-Mdl::JourneyPatternStopUsage
to
from
to
JL_1b : Txc-SvcPtn-Mdl::JourneyPatternStopUsage
JL_3a : Txc-SvcPtn-Mdl::JourneyPatternStopUsage
JL_2b : Txc-SvcPtn-Mdl::JourneyPatternStopUsage
JL_3b : Txc-SvcPtn-Mdl::JourneyPatternStopUsage
stop
stop
stop
stop
R_1 : Txc-Rte-Mdl::Route
section (1)
stop
link (3)
RS_1 : Txc-Rte-Mdl::RouteSection
link (2)
link (1)
RL_3 : Txc-Rte-Mdl::RouteLink
RL_2 : Txc-Rte-Mdl::RouteLink
track (1)
RL_1 : Txc-Rte-Mdl::RouteLink
track (1)
track (1)
stop
track(2)
to
T_3 : Txc-Rte-Mdl::Track
from
T_1 : Txc-Rte-Mdl::Track
to
from
T_2_1 : Txc-Rte-Mdl::Track
from
to
S1
S2
T_2_2 : Txc-Rte-Mdl::Track
S4
S5
T1_g1
t2_1_g1
t1_g2
t2_2_g1
t3_1_g1
t1_g3
t2_1_g2
t2_2_g2
t3_1_g2

Figure 3-10 – UML Instance Diagram of Example of Link Model

3.4 Inheriting Timing Link Values

Table 3-6 shows the various values that may be specified for the ***VehicleJourney*** and ***VehicleJourneyTimingLink*** elements, and whether they are:

(i) **Required** [‘*R*’].
(ii) **Optional but otherwise inherited** from the previous level of discourse [‘*O*’].
(iii) **Always** inherited [‘*I*”].

The most significant properties are the actual run and wait times of each timing link, but several other operational values, such as fare stages, may also be specified.

For elements that are optional at all levels, a default value is identified to use if no explicit value is provided. For some ‘successive’ properties, such as fare stage number, the value in effect from any previous link is assumed unless specified otherwise. This is indicated by a [‘*S*’].

		Level of Discourse				
			→	→	→	
Level	**Property**	***Serv ice***	***Route***	***Journey Pattern***	***Vehicle Journey***	**Default Value**
Pattern	***ServiceRef***		--	(R)	I	
	Direction	O	**--**	O	O	Outbound
	OperatorRef	**R**	--	O	O	Service / RegisteredOperator)
	DestinationDisplay	(**R**)	--	O	O	Service /Destination
	TicketMachineServiceCode	O	--	O	O	none
	TicketMachine / JourneyCode		--	O	O	none
	TicketMachine / Direction		--	O	O	Direction
	Block / Board		--	O	O	none
	Block / BoardNumber		--	O	O	none
	Block / Note		--	O	O	none
	GarageRef		--	O	O	none
	VehicleType		--	O	O	none
	LayoverPoint		--	O	O	none
	TimeDemand		--	O	O	none
	Frequency		--	O	O	false
	OperatingProfile	O	--	O	O	Monday to Friday, Every Day of Year
	LineRef	O	--	--	**R**	--
	DepartureTime		--	--	**R**	--
Section	order		--	O	I	None
↓						
TimingLink	***LinkRef***		--	O	**R**	--
	Direction	O	**R**	O	I	JourneyPattern / Direction
	RunTime		**--**	**R**	O	--
	Distance		O	O	I	zero
	DestinationDisplay		--	O	O	none (same as Pattern / DestinationDisplay)
	HailAndRide		O	O	O	false
	DutyCrewCode		--	O (S)	O (S)	none
	StoppingArrangements		--	O	O	none
↓						
TimingLink StopUsage	***StopPointRef***		**(R)**	**R**	I	--
	TimingStatus		**--**	O	I	TIP
	Activity		--	O	O	PickUpAndSetDown
From & To	***WaitTime***		(++)	O	O	zero
	VariableStopAllocation			O	O	none
	FareStageNumber		--	O (S)	I	none
	FareStage		--	O	I	false

Table 3-6 – Journey Properties and Defaults

++ A default wait time may be specified on stops. This merely sets a default that may be used to set the initial value used by services. Each journey pattern sets the wait value on each timing link.

Figure 3-12shows how inheritance relationships are used in the *TransXChange* supply model so as to express the shared attributes and common data structure of equivalent elements, that is, the elements and subelements of ***JourneyPattern*** and ***VehicleJourney***. For each element type, an abstract class is used to represent the common properties, and distinct subtypes describe any specific differences. For example, ***AbstractTimingLink*** has subtypes ***JourneyPatternTimingLink*** and ***VehicleJourneyTimingLink***.

- A **VehicleJourney** may override any common property it shares with a **JourneyPattern.**

- A ***VehicleJourneyTimingLink*** may override any common property it shares with a ***JourneyPatternTimingLink*****.**

- A ***VehicleJourneyStopUsage*** may override any common property it shares with a ***JourneyPatternStopUsage*****.**

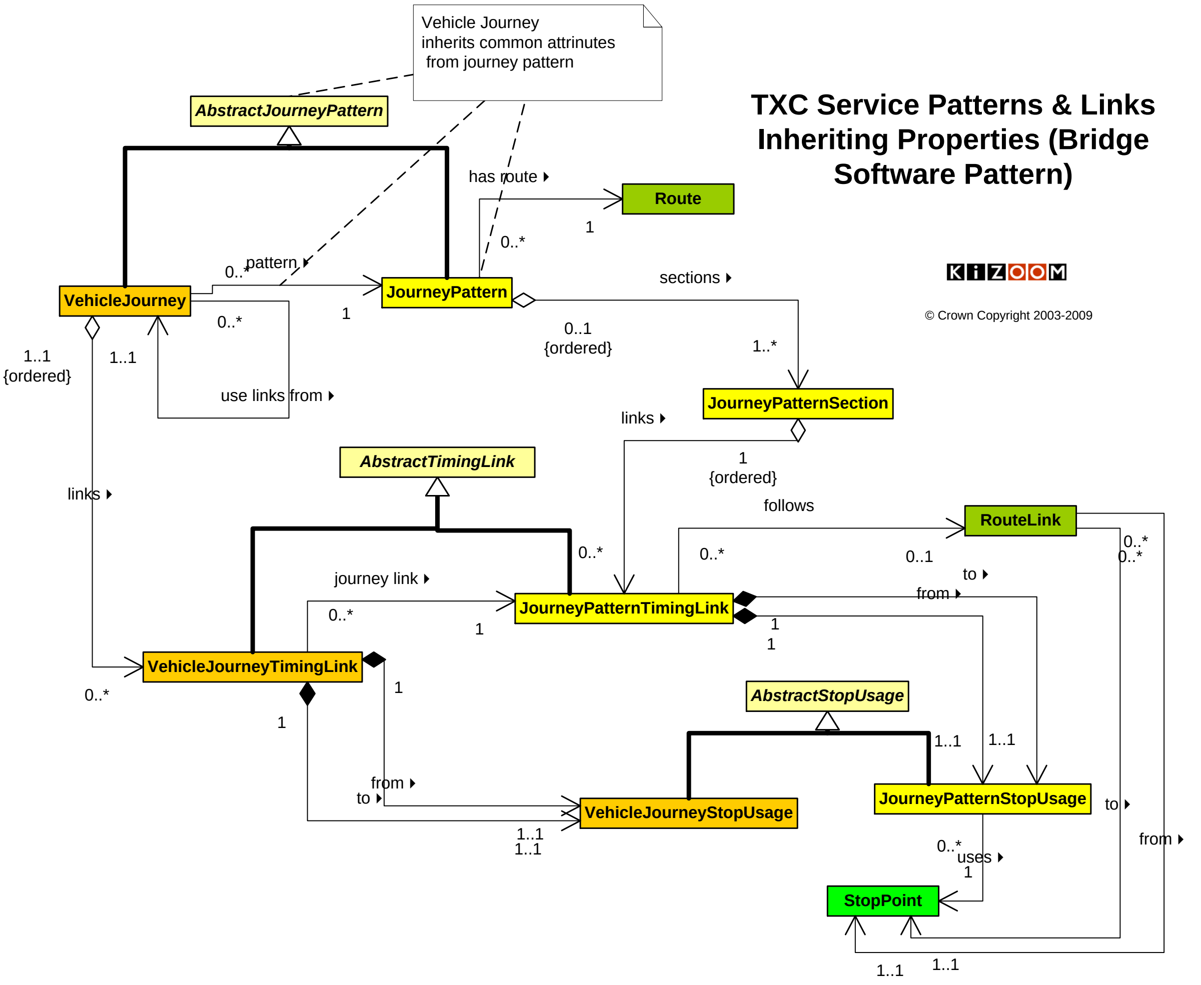


Figure 3-11 – UML Diagram of Service Pattern elements

3.4.1 Inheritable attributes

Figure 3-12 shows the attributes of ***JourneyPattern*** and ***VehicleJourney***. ***JourneyPatternTimingLink***, and ***VehicleJourneyTimingLink, etc.***

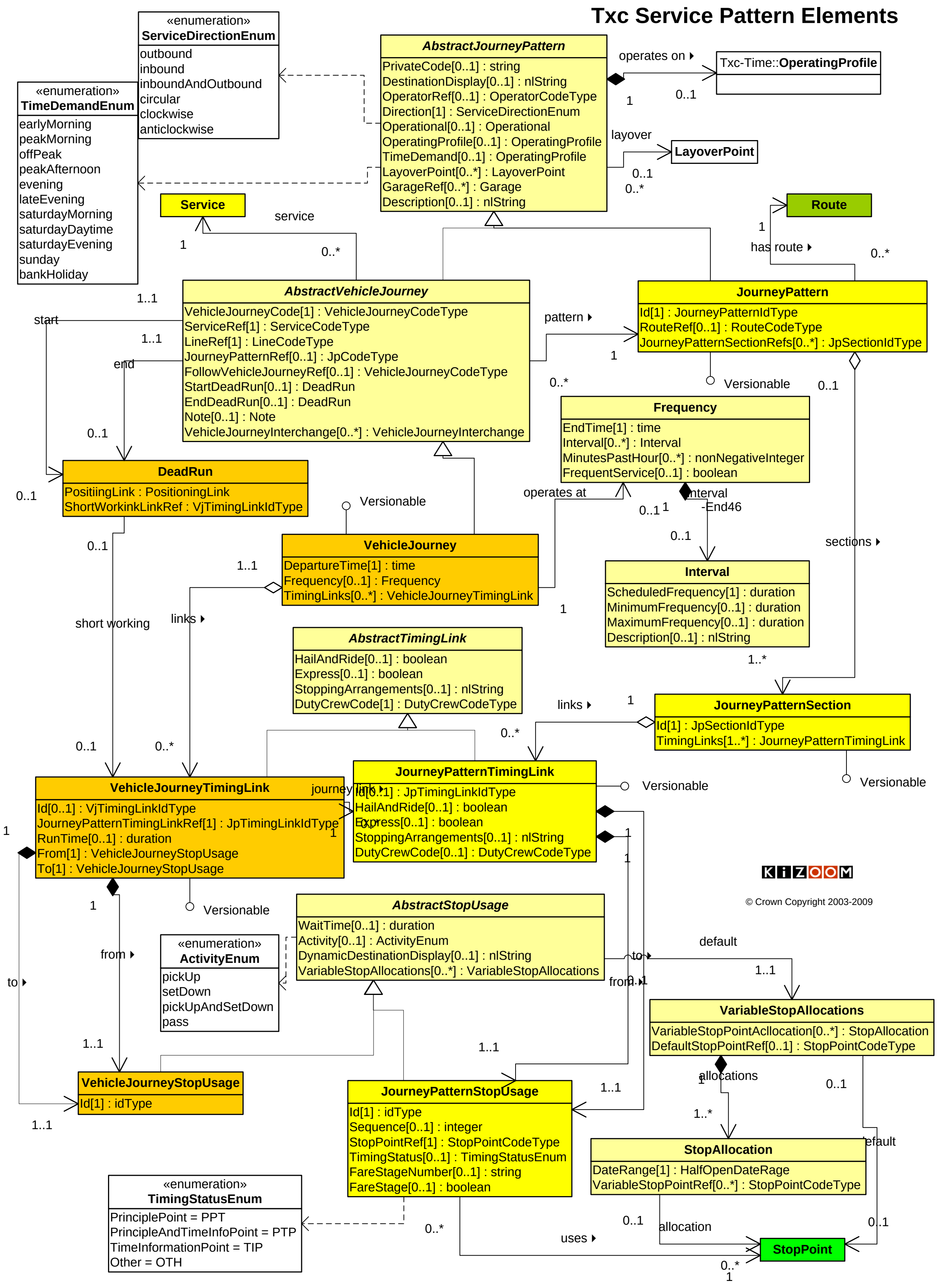

Txc Service Pattern Elements
«enumeration»
ServiceDirectionEnum
outbound
inbound
inboundAndOutbound
circular
clockwise
anticlockwise
«enumeration»
TimeDemandEnum
earlyMorning
peakMorning
offPeak
peakAfternoon
evening
lateEvening
saturdayMorning
saturdayDaytime
saturdayEvening
sunday
bankHoliday
AbstractJourneyPattern
PrivateCode[0..1] : string
DestinationDisplay[0..1] : nlString
OperatorRef[0..1] : OperatorCodeType
Direction[1] : ServiceDirectionEnum
Operational[0..1] : Operational
OperatingProfile[0..1] : OperatingProfile
TimeDemand[0..1] : OperatingProfile
LayoverPoint[0..*] : LayoverPoint
GarageRef[0..*] : Garage
Description[0..1] : nlString
operates on
1
0..1
Txc-Time::OperatingProfile
layover
LayoverPoint
0..1
0..*
Service
service
1
0..*
Route
1
has route
0..*
AbstractVehicleJourney
VehicleJourneyCode[1] : VehicleJourneyCodeType
ServiceRef[1] : ServiceCodeType
LineRef[1] : LineCodeType
JourneyPatternRef[0..1] : JpCodeType
FollowVehicleJourneyRef[0..1] : VehicleJourneyCodeType
StartDeadRun[0..1] : DeadRun
EndDeadRun[0..1] : DeadRun
Note[0..1] : Note
VehicleJourneyInterchange[0..*] : VehicleJourneyInterchange
1..1
start
1..1
end
0..1
0..1
pattern
1
0..*
JourneyPattern
Id[1] : JourneyPatternIdType
RouteRef[0..1] : RouteCodeType
JourneyPatternSectionRefs[0..*] : JpSectionIdType
Versionable
0..1
Frequency
EndTime[1] : time
Interval[0..*] : Interval
MinutesPastHour[0..*] : nonNegativeInteger
FrequentService[0..1] : boolean
DeadRun
PositiingLink : PositioningLink
ShortWorkinkLinkRef : VjTimingLinkIdType
Versionable
operates at
interval
-End46
0..1
1
0..1
sections
VehicleJourney
DepartureTime[1] : time
Frequency[0..1] : Frequency
TimingLinks[0..*] : VehicleJourneyTimingLink
1..1
1
Interval
ScheduledFrequency[1] : duration
MinimumFrequency[0..1] : duration
MaximumFrequency[0..1] : duration
Description[0..1] : nlString
short working
links
AbstractTimingLink
HailAndRide[0..1] : boolean
Express[0..1] : boolean
StoppingArrangements[0..1] : nlString
DutyCrewCode[1] : DutyCrewCodeType
1..*
links
1
JourneyPatternSection
Id[1] : JpSectionIdType
TimingLinks[1..*] : JourneyPatternTimingLink
0..1
0..*
0..*
VehicleJourneyTimingLink
Id[0..1] : VjTimingLinkIdType
JourneyPatternTimingLinkRef[1] : JpTimingLinkIdType
RunTime[0..1] : duration
From[1] : VehicleJourneyStopUsage
To[1] : VehicleJourneyStopUsage
journeyPattern link
1
JourneyPatternTimingLink
Id[0..1] : JpTimingLinkIdType
HailAndRide[0..1] : boolean
Express[0..1] : boolean
StoppingArrangements[0..1] : nlString
DutyCrewCode[0..1] : DutyCrewCodeType
Versionable
Versionable
1
1
1
1
Versionable
KIZOOM
© Crown Copyright 2003-2009
«enumeration»
ActivityEnum
pickUp
setDown
pickUpAndSetDown
pass
AbstractStopUsage
WaitTime[0..1] : duration
Activity[0..1] : ActivityEnum
DynamicDestinationDisplay[0..1] : nlString
VariableStopAllocations[0..*] : VariableStopAllocations
from
to
to
from
0..1
default
1..1
VariableStopAllocations
VariableStopPointAcllocation[0..*] : StopAllocation
DefaultStopPointRef[0..1] : StopPointCodeType
1..1
1..1
VehicleJourneyStopUsage
Id[1] : idType
1..1
JourneyPatternStopUsage
Id[1] : idType
Sequence[0..1] : integer
StopPointRef[1] : StopPointCodeType
TimingStatus[0..1] : TimingStatusEnum
FareStageNumber[0..1] : string
FareStage[0..1] : boolean
1..1
allocations
1
0..1
1..*
StopAllocation
DateRange[1] : HalfOpenDateRage
VariableStopPointRef[0..*] : StopPointCodeType
default
«enumeration»
TimingStatusEnum
PrinciplePoint = PPT
PrincipleAndTimeInfoPoint = PTP
TimeInformationPoint = TIP
Other = OTH
0..*
uses
0..1
allocation
0..1
StopPoint
0..*
1

Figure 3-12 – UML Diagram of VehicleJourney & JourneyPattern Inheritable Properties

3.4.2 Schedule and Journey Terms and Definitions

The *TransXChange* uses the following definitions of common scheduling terms. See also the definitions of individual schema elements. Some of the terms are used in actually element names; others merely define concepts.

3.4.2.1 Time Related Terms

- *Relative time:* Time as a duration, usually in minutes, for example, '*5 minutes'*.
- *Absolute time:* Time as a specific clock hour, for example, '*10:00*', '18:30'.
- *Overall Wait time:* Relative time to wait at a specific stop, assuming bus arrives on time. Used to compute passing times. In real-time operations, if bus is late at a stop, wait time may be reduced to the minimum time need to disembark and board passengers, i.e. wait is a buffer time used to adhere to schedule. The actual time waited is the *Dwell time* - which is an operational time and not relevant to *TransXChange.* Note that wait time is a property of a journey pattern or vehicle journey, not of the stop itself, since it may be different on different journeys using the same stop. In *TransXChange,* the overall wait time is computed from two separate component timing link wait times that are stated on each end of the incoming and outgoing ***JourneyPatternTimingLink*** or ***VehicleJourneyTimingLink*** instances :
  - See ***JourneyPatternStopUsage / WaitTime***
  - See ***VehicleJourneyStopUsage / WaitTime***.
- *Run time.* Relative time taken to traverse a timing link.
  - See ***JourneyPatternTimingLink / RunTime***
  - See ***VehicleJourneyTimingLink / RunTime***.
- *Departure Time:* The absolute time at which a vehicle journey leaves from its first stop.
  - See ***VehicleJourney / DepartureTime***.
- *Passing time:* Absolute time that a bus reaches a stop. Comprises the departure time from the previous stop, plus the run time for the timing link connecting the previous stop and the next stop. Derived.
- *Frequency Based Service:* A service that runs to a regular frequency, for example '*every 5 minutes'*, rather than to a specific timetable. May or may not be a strict Frequent Service.
  - See ***VehicleJourney / Frequency***.
- *Frequent Service*, a service that runs to a frequency of every 10 minutes or less in accordance with the Statutory Requirement, and that has been formally registered as constituting a *Frequent Service*. Normally, but not necessarily, a *Frequency Based Service.*
  - See ***VehicleJourney / Frequency/FrequentService***.
- *Day Type:* A type of day or day such as Monday, Weekday, or Weekend as opposed to a calendar date.

3.4.2.2 Routing Related Terms

- *Block:* A description of a group of journeys to be operated by a particular vehicle, in a specific working period, normally covering a full working day. Also called in English a *Running Board*. May be identified by a *block number*.
  - See ***JourneyPattern / Block / Description***.
  - See ***JourneyPattern / Block / BlockNumber***.
- *Origin:* The place that the service goes from. Does not vary; note however that some journeys of the service may have a '*short working'.*
  - See ***Service*** / ***Origin***.
- *Destination:* The place to which the service goes. Does not vary; Note however that some journeys of the service may have a '*short working'.*

- See ***Service*** / ***Destination***.

- *Destination Display:* Name of a destination to which the bus ultimately goes. Fixed for whole journey.
  - See ***JourneyPattern / DestinationDisplay.***
  - See ***VehicleJourney / DestinationDisplay***.
- *Dynamic Destination Display:* Name of a destination where the bus is currently considered to be heading, shown on the front of the bus. Also known as the *Heading.* On a circular or other route with a complex topology, the destination display may change from stop to stop. On a linear route, normally the same as the destination display, but on a short working may be an earlier point in the pattern.
  - See ***JourneyPatternTimingLink / DestinationDisplay.***
  - See ***VehicleJourneyTimingLink / DestinationDisplay***.
- *Stop List.* The actual list of stops at which the bus will stop, in order of visiting. Sometimes also termed the '*calling pattern'*.
- *Direction*: relative course of a bus following a vehicle journey – may be outbound, inbound, clockwise or anti-clockwise.
  - ***JourneyPattern / Direction, JourneyPatternTimingLink / Direction***.
  - See ***VehicleJourneyTimingLink / Direction***.
- *Bearing*, Absolute, i.e. compass direction of a bus along a street, e.g. 'North'.
  - See ***StopPoint / Bearing***.
- *Layover Point:* Point at which a bus may stop and wait until it is time to start the next service stage.
  - See ***JourneyPattern / LayoverPoint***.
- *Short Working:* A vehicle journey that follows a journey pattern but omits one or more stops at one or other end of the journey.
  - See ***VehicleJourney / DeadRun / EndStopUsage***.
- *Express Journey:* A vehicle journey that follows a journey pattern but passes certain stops without stopping (also referred to as a *Limited Stop Journey*).
  - See ***JourneyPatternTimingLink / Activity.***
- *Stop Footprint*: The geometry of the stop coverage. Most stops are points. Some stop types however have a footprint that covers more than a single point, for example hail and ride sections, or flexible zones.

3.4.3 Computation of Passing Times

The passing time at each stop (see *Figure 3-13*) is calculated from the cumulative sum of the individual timing link values for all preceding stops in the journey link sequence as follows:

[1] Arrival time at stop$_n$ = Departure time from previous stop $_{n-1}$ + (Run time for inbound link from stop $_{n-1}$)

[2]. Departure time at stop$_n$ = Arrival time at stop$_n$ + Wait time for destination end of inbound link from stop$_{n-1).}$ + Wait time for origin of outbound link to stop $_{n+1}$

Where:

1. Default **vehicle journey wait** times for each link are derived from the journey pattern timing link onto which the vehicle journey timing link projects (i.e. through the ***VehicleJourneyTimingLink / JourneyPatternTimingLinkRef),*** as follows:
   - If no value for wait time is specified on the *departure* end of the timing link, i.e. for the ***VehicleJourneyTimingLink*** / ***From*** / ***VehicleJourneyStopUsage***, the default ***WaitTime*** from the corresponding ***JourneyPatternTimingLink*** / ***From*** / ***JourneyPatternStopUsage*** is used.
   - If no value for wait time is specified on the *arrival* end of the timing link, i.e. the ***VehicleJourneyTimingLink*** / ***To*** / ***VehicleJourneyStopUsage***, the default ***WaitTime*** from the corresponding ***JourneyPatternTimingLink*** / ***To*** / ***JourneyPatternStopUsage*** is used.

2. If unspecified, journey pattern **wait** times are defaulted as follows:
   - If no value for wait time is specified on the *departure* end of the timing link, i.e. the ***JourneyPatternTimingLink*** / ***From*** / ***JourneyPatternStopUsage***, a value of **zero** is used.
   - If no value for wait time is specified on the *arrival* end of the timing link, i.e. the ***JourneyPatternTimingLink*** / ***To*** / ***JourneyPatternStopUsage***, a value of **zero** is assumed.

3. Default vehicle journey **run** times for each link are derived from the journey pattern timing link onto which the vehicle journey timing link projects. A run time is mandatory on each ***JourneyPatternTimingLink.***

The structured example shown earlier gives a simple example of how passing times are derived from run times and wait times.

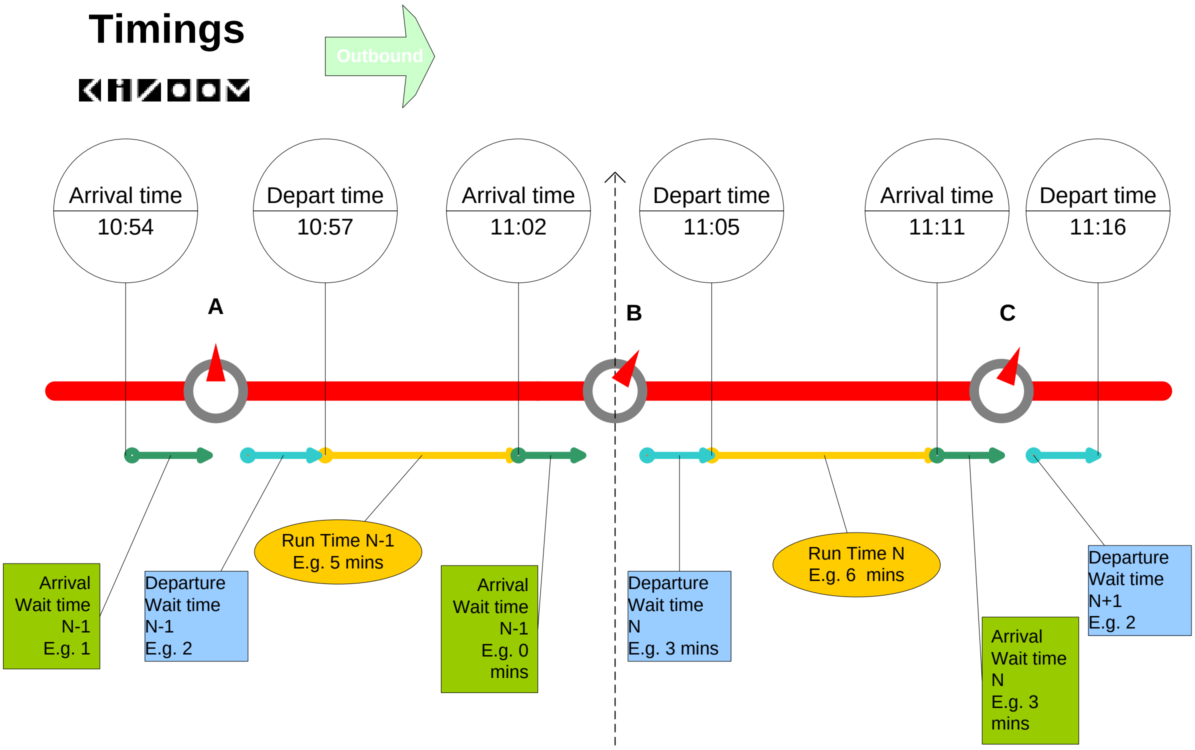

Timings
Outbound
Arrival time 10:54
Depart time 10:57
Arrival time 11:02
Depart time 11:05
Arrival time 11:11
Depart time 11:16
A
B
C
Arrival Wait time N-1 E.g. 1
Departure Wait time N-1 E.g. 2
Run Time N-1 E.g. 5 mins
Arrival Wait time N-1 E.g. 0 mins
Departure Wait time N E.g. 3 mins
Run Time N E.g. 6 mins
Arrival Wait time N E.g. 3 mins
Departure Wait time N+1 E.g. 2

Figure 3-13 – Computation of Passing Times

3.4.3.1 Example of Inheritance of Passing Times

Table 3-7 shows a more complex example, where wait and run times are specified at different levels of discourse, that is, default values from the journey pattern are used except where overridden by the vehicle journey. For each step, the wait and run times are added to values from the previous step to arrive at an overall passing time. There are three stops S1, S2, S3 and two links (L1. L2) between them.

- An initial time of '*10:00'* is specified.
- Run time *R1 (*5 minutes*)* on the vehicle journey pattern timing link (L1) is defaulted from the journey pattern timing link.
- Run time *R2 (*10 minutes*)* on the vehicle journey pattern timing link (L2) overrides the default (14 minutes) on the journey pattern.
- Departure wait time *W1b* at S1 (2 minutes) on the vehicle journey timing link end L1a overrides the default (0 minutes) on the journey pattern.
- Arrival Wait time *W2a* (5 minutes) at S2 on the vehicle journey timing link end L1b is defaulted from the journey pattern.
- Departure wait time *W2b* at S2 (7 minutes) on the vehicle journey timing link end L2a overrides the default (6 minutes) on the journey pattern.
- Arrival Wait time *W3a (*10 minutes*)* at S3 on the vehicle journey timing link end L2b overrides the default (5 minutes) on the journey pattern.
- Departure wait time *W3b* at S3 (5 minutes) - which would come from a successor link L3) can be used to compute the departure time from S3 i

Stop			**Link**							**Usage**			
			Wait Time			**Run Time**				**Computation**		**Passing Time**	
	T		**JP**	**VJ**	**Act-ual**	**id**	**JP mns**	**VJ mns**	**Actual mns**		**T**		**Actual**
											t1		10:00
s1	-	**-**	--	--	*0*					-		**a**	

	w1b	**From**	*(+0)*	--	*+2*	**L1a**				*t1 + w1b*	*t2*	**d**	10:02
	r1					**L1**	+5	--	+5	-			
s2	*w2a*	**To**	+5	--	+5	**L1b**				*t2 + r1*	*t3*	**a**	10:07
	w2b	**From**	*(+6)*	*+7*	*+7*	**L2a**				*t3 + w2a + w2b*	*t4*	**d**	10:19
	r2					**L2**	*(+14)*	*+10*	*+10*				
s3	*w3a*	**To**	*(+5)*	*+10*	*+10*	**L2b**				*t4 + r2*	*t5*	**a**	10:29
	w3b	**From**	--	*+5*	*+5*	**L3a**				*t5 + w3a + w3b*	*t6*	**d**	10:34
						L3	..	..	..				
		To.				**L3b**							

Table 3-7 – Example of Computation of Inherited Passing Times

3.5 Rounding of Passing Times

Run and wait times are specified as values of type ***Duration***, which may include seconds, for example *PT10M55S*. The TransXChange publisher computes departure times using the full value including seconds, but in the matrix timetable rounds down the total cumulative time to the nearest whole minute, i.e. the rounded value is not used to reset the cumulative time. Table 3-8 gives an example.

Stop	Run Time	Cumulative Time	Show As
A		7:00:00	7:00
B	PT20M50S	7:20:50	7:20
C	PT20M50S	7:41:40	7:41
D	PT10M55S	7:52:35	7:52

Table 3-8 – Example of Rounding of Passing Times

3.6 Standard Service Overview

Figure 3-14 gives a slightly more detailed view of the central *TransXChange* model introduced earlier, summarising the overall structure of a ***StandardService***, and showing again that ***JourneyPattern,*** and ***VehicleJourney*** are made up of collections of timing links (***JourneyPatternTimingLink,*** and ***VehicleJourneyTimingLink*** respectively), which hold the details about each individual step between stops of the journey.

- Each timing link has information about the arrival and departure of the vehicle at a stop, specified with a stop usage element (***JourneyPatternStopUsage,*** and ***VehicleJourneyStopUsage*** respectively).

- For Bus Stations, stop i.e. bay allocation may be variable, specified by a ***VariableStopAllocation***.

A ***StandardService*** describes the fixed route component of a ***Service***.

- Each ***Service*** can have one or more ***Line*** instances associated with it, this specifes a label to be associated with journeys., fro example, “N93”.

- Each ***StandardService*** must have one or more ***JourneyPattern*** instances.
    - A ***JourneyPattern*** instance may reference a Route and a Track.

- The ***StandardService*** must have one or more ***VehicleJourney*** instances. Each ***VehicleJourney*** instances must reference a ***JourneyPattern*** of the same ***StandardService,*** and a ***Line*** .instance of the ***Service*** to which it belongs.

- Each ***VehicleJourney*** must specify a ***DepartureTime***: Frequency based services may also describe a ***Frequency***. See 3.15.7 below.

Connections with other services are described by interchanges. These are described in *Section 3.8*.

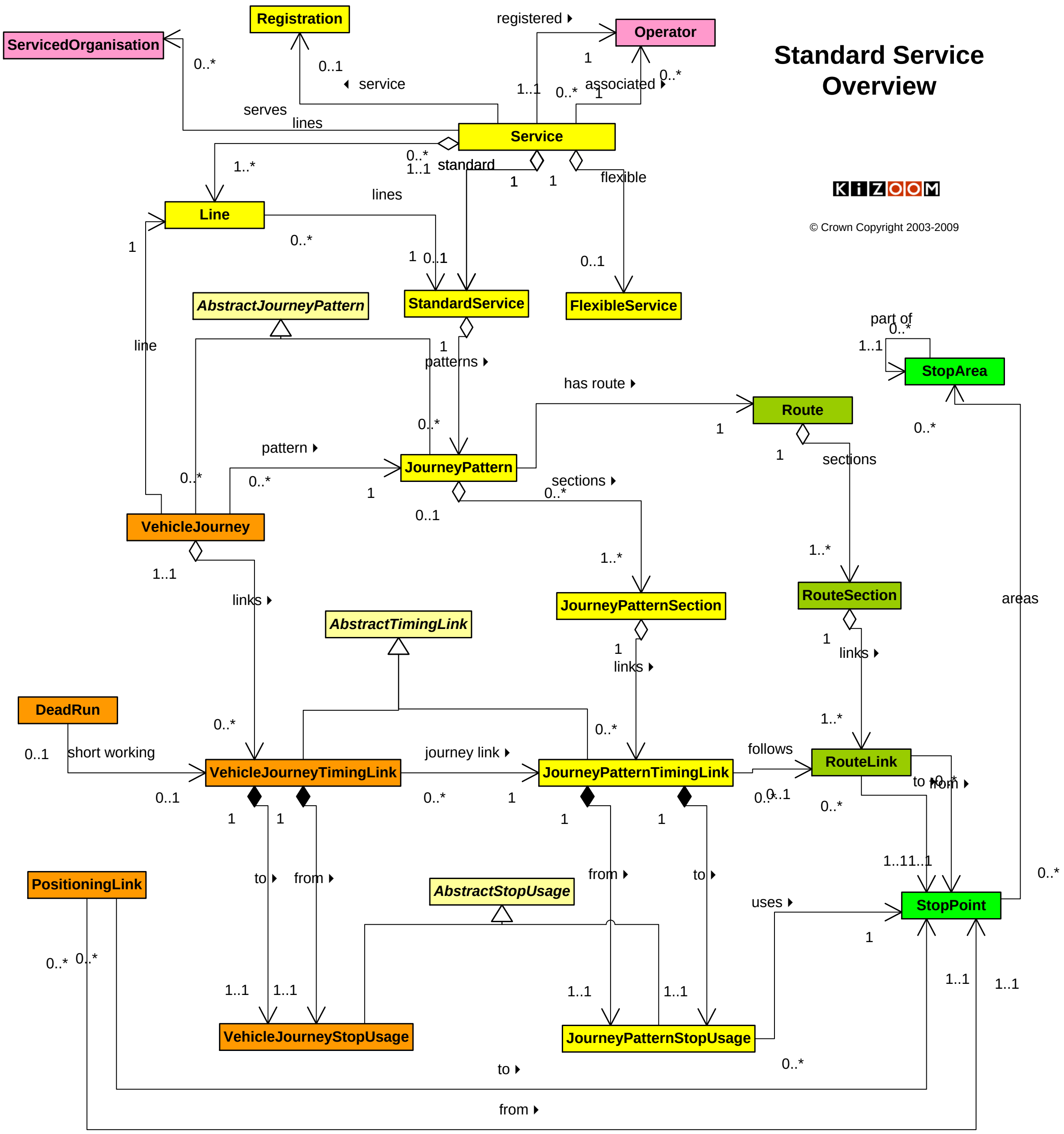


Figure 3-14 – UML Diagram of Standard Service

3.6.1 Standard Service properties

Figure 3-15 shows further details of a ***StandardService*** including a ***ServiceClassification***

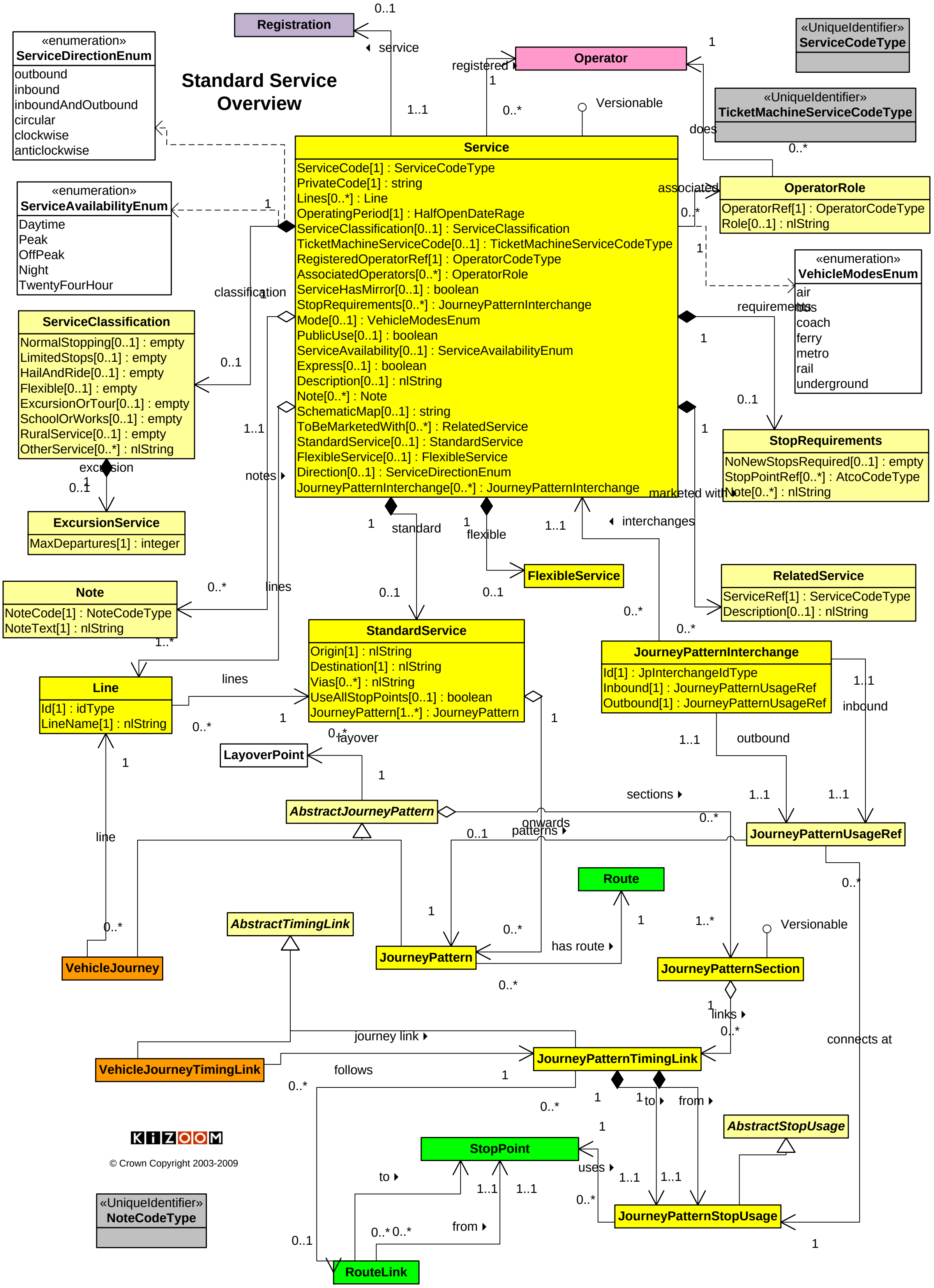

Standard Service Overview
Registration
0..1
service
registered
Operator
1
«UniqueIdentifier» ServiceCodeType
«UniqueIdentifier» TicketMachineServiceCodeType
1..1
0..*
Versionable
does
0..*
«enumeration» ServiceDirectionEnum
outbound
inbound
inboundAndOutbound
circular
clockwise
anticlockwise
Service
ServiceCode[1] : ServiceCodeType
PrivateCode[1] : string
Lines[0..*] : Line
OperatingPeriod[1] : HalfOpenDateRage
ServiceClassification[0..1] : ServiceClassification
TicketMachineServiceCode[0..1] : TicketMachineServiceCodeType
RegisteredOperatorRef[1] : OperatorCodeType
AssociatedOperators[0..*] : OperatorRole
ServiceHasMirror[0..1] : boolean
StopRequirements[0..*] : JourneyPatternInterchange
Mode[0..1] : VehicleModesEnum
PublicUse[0..1] : boolean
ServiceAvailability[0..1] : ServiceAvailabilityEnum
Express[0..1] : boolean
Description[0..1] : nlString
Note[0..*] : Note
SchematicMap[0..1] : string
ToBeMarketedWith[0..*] : RelatedService
StandardService[0..1] : StandardService
FlexibleService[0..1] : FlexibleService
Direction[0..1] : ServiceDirectionEnum
JourneyPatternInterchange[0..*] : JourneyPatternInterchange
associated
0..*
OperatorRole
OperatorRef[1] : OperatorCodeType
Role[0..1] : nlString
1
«enumeration» ServiceAvailabilityEnum
Daytime
Peak
OffPeak
Night
TwentyFourHour
1
«enumeration» VehicleModesEnum
air
bus
coach
ferry
metro
rail
underground
classification
1
requirements
1
ServiceClassification
NormalStopping[0..1] : empty
LimitedStops[0..1] : empty
HailAndRide[0..1] : empty
Flexible[0..1] : empty
ExcursionOrTour[0..1] : empty
SchoolOrWorks[0..1] : empty
RuralService[0..1] : empty
OtherService[0..*] : nlString
0..1
1..1
0..1
1
StopRequirements
NoNewStopsRequired[0..1] : empty
StopPointRef[0..*] : AtcoCodeType
Note[0..*] : nlString
excursion
1
0..1
notes
marketed with
ExcursionService
MaxDepartures[1] : integer
1
standard
1
flexible
1..1
interchanges
FlexibleService
Note
NoteCode[1] : NoteCodeType
NoteText[1] : nlString
0..*
lines
1..*
0..1
0..1
0..*
RelatedService
ServiceRef[1] : ServiceCodeType
Description[0..1] : nlString
0..*
StandardService
Origin[1] : nlString
Destination[1] : nlString
Vias[0..*] : nlString
UseAllStopPoints[0..1] : boolean
JourneyPattern[1..*] : JourneyPattern
JourneyPatternInterchange
Id[1] : JpInterchangeIdType
Inbound[1] : JourneyPatternUsageRef
Outbound[1] : JourneyPatternUsageRef
Line
Id[1] : idType
LineName[1] : nlString
lines
0..*
1
1
1..1
inbound
0..*
layover
LayoverPoint
1..1
outbound
1
1
sections
1..1
1..1
AbstractJourneyPattern
0..*
line
0..1
onwards
patterns
JourneyPatternUsageRef
0..*
Route
0..*
AbstractTimingLink
1
0..*
1
1..*
Versionable
has route
VehicleJourney
JourneyPattern
JourneyPatternSection
0..*
1
links
0..*
journey link
connects at
VehicleJourneyTimingLink
JourneyPatternTimingLink
follows
1
0..*
1
1
to
from
0..*
AbstractStopUsage
1
KIZOOM
© Crown Copyright 2003-2009
StopPoint
uses
to
1..1
1..1
1..1
1..1
0..*
«UniqueIdentifier» NoteCodeType
from
0..* 0..*
JourneyPatternStopUsage
0..1
1
RouteLink

Figure 3-15 – UML Diagram of Standard Service Details

3.7 Flexibly Routed Services

The *TransXChange* model can also support flexibly routed services (*Figure 3-16*).
A flexible service operates between catchment areas that can be made up of both spatial zones, and lists of fixed stops, allowing combinations of (i) area-to-fixed stop, (ii) area-to-area, (iii) fixed stop-to-fixed stop.Within a zone there is no fixed or marked stop, but the service will call on demand.

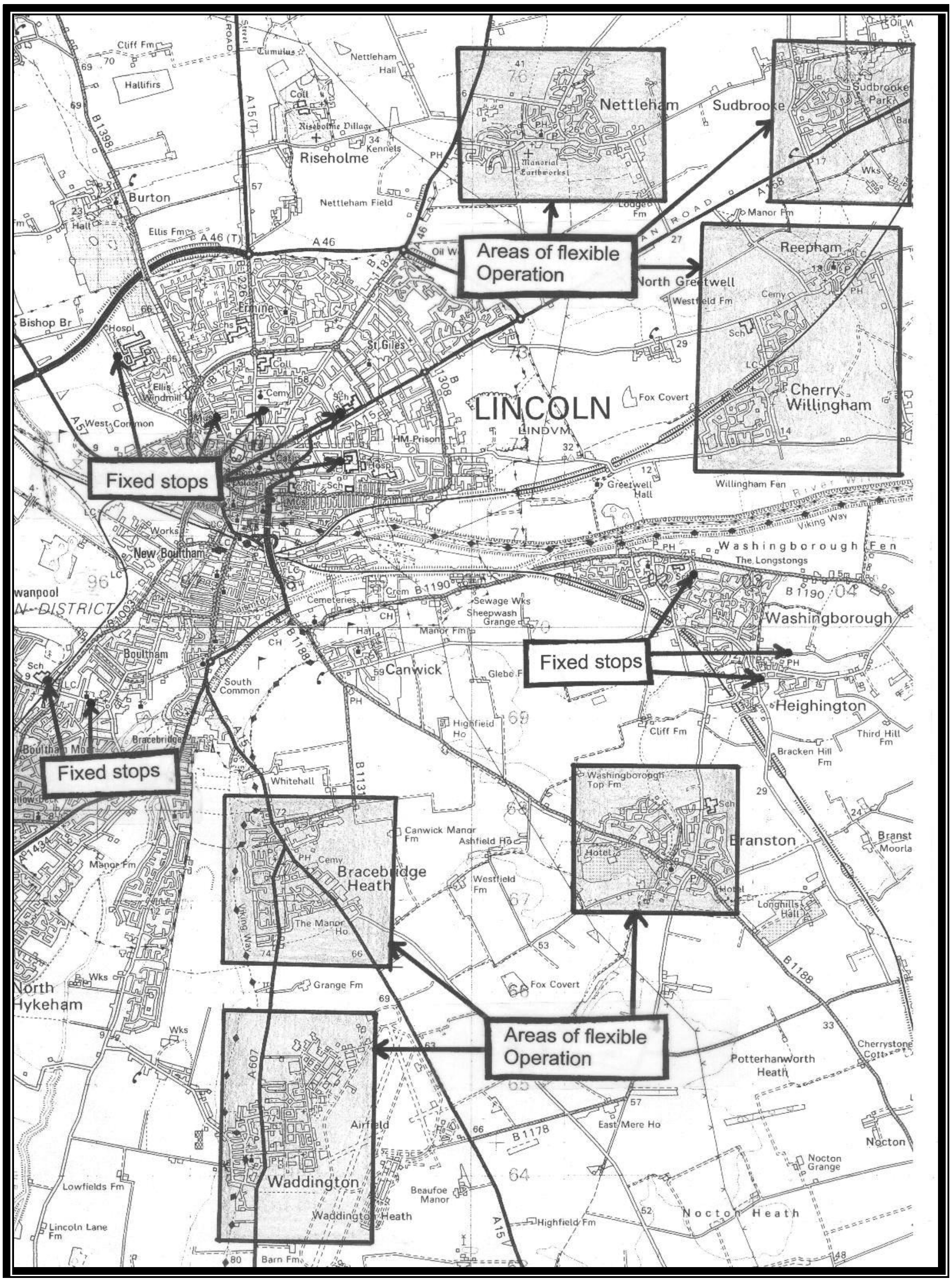


Figure 3-16 – Flexible Network

Representing a flexible service in *TransXChange* requires the additional concept of a ***FlexibleService*** (see *Figure 3-17*, in UML notation), with which to specify the stops visited.

- A ***FlexibleService*** has a ***FlexibleJourneyPattern,*** which must include some *NaPTAN* stops of type ***FlexibleZone*** (*FLX*) to define areas within which passengers may be picked up or set down.
    - A ***FlexibleZone*** must be a contiguous area. Like other *NaPTAN* stop types, a ***FlexibleZone*** stop can be associated with one or more *NPTG* Localities: the locality with the greatest correspondence to the area of the zone should be used as the primary *NPTG* Locality; other localities that the zone falls within should be specified as alternative *NPTG* localities on the *NaPTAN* stop definition. Where a flexible zone substantially covers two or more NPTG Localities, it is preferable to define two separate zones, one for each locality.
    - A ***FlexibleJourneyPattern*** may also have one or more ***FixedStopPoint*** instances that can be visited in any order by the flexible service. Fixed stops should be *NaPTAN* stops of a type other than ***FlexibleZone*** (*FLX*).
    - The allowed activity (pick up, set down etc) and other behaviour of the service at each stop, fixed or flexible, is defined by a stop usage instance for each stop used.
- A ***FlexibleVehicleJourney*** describes the actual operation of the flexible service, using a ***FlexibleServiceTimes*** element to specify the time bands during which the service operates.
- A ***Service*** may contain both ***FlexibleService*** and ***StandardService*** components. Interchange elements can be used to define the transition between flexible and fixed stages.
- Other properties of the service, such as ***Registration***, ***Operator***, ***Line*** and ***OperatingProfile,*** are specified with the same elements as for a ***StandardService***.

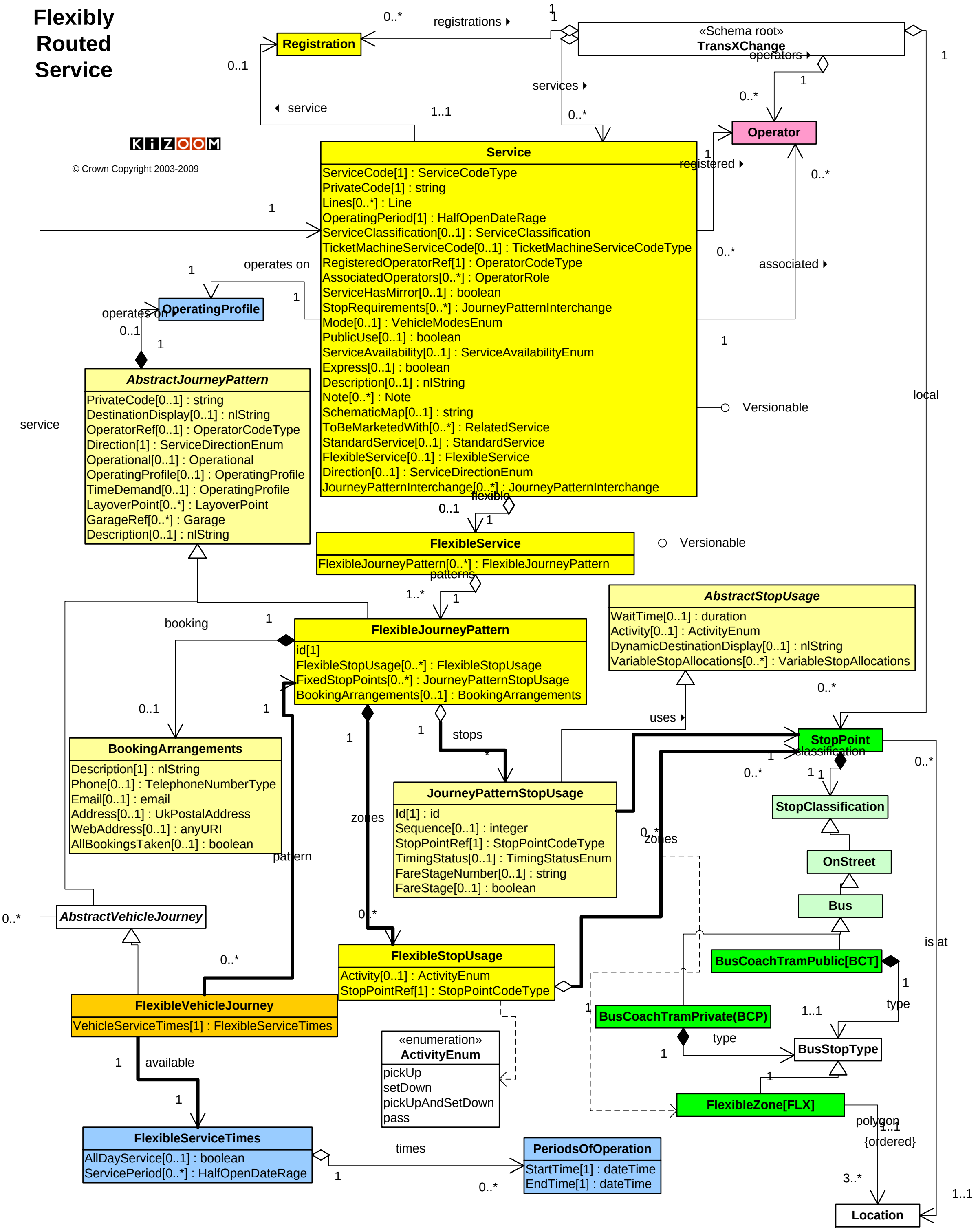

Flexibly Routed Service
KiZOOM
© Crown Copyright 2003-2009
Registration
0..*
registrations ▸
1
1
«Schema root»
TransXChange
operators ▸
0..1
◂ service
1..1
services ▸
0..*
1
0..*
Operator
Service
ServiceCode[1] : ServiceCodeType
PrivateCode[1] : string
Lines[0..*] : Line
OperatingPeriod[1] : HalfOpenDateRage
ServiceClassification[0..1] : ServiceClassification
TicketMachineServiceCode[0..1] : TicketMachineServiceCodeType
RegisteredOperatorRef[1] : OperatorCodeType
AssociatedOperators[0..*] : OperatorRole
ServiceHasMirror[0..1] : boolean
StopRequirements[0..*] : JourneyPatternInterchange
Mode[0..1] : VehicleModesEnum
PublicUse[0..1] : boolean
ServiceAvailability[0..1] : ServiceAvailabilityEnum
Express[0..1] : boolean
Description[0..1] : nlString
Note[0..*] : Note
SchematicMap[0..1] : string
ToBeMarketedWith[0..*] : RelatedService
StandardService[0..1] : StandardService
FlexibleService[0..1] : FlexibleService
Direction[0..1] : ServiceDirectionEnum
JourneyPatternInterchange[0..*] : JourneyPatternInterchange
1
registered ▸
0..*
0..*
associated ▸
1
Versionable
1
1
operates on
1
OperatingProfile
operates on
0..1
1
AbstractJourneyPattern
PrivateCode[0..1] : string
DestinationDisplay[0..1] : nlString
OperatorRef[0..1] : OperatorCodeType
Direction[1] : ServiceDirectionEnum
Operational[0..1] : Operational
OperatingProfile[0..1] : OperatingProfile
TimeDemand[0..1] : OperatingProfile
LayoverPoint[0..*] : LayoverPoint
GarageRef[0..*] : Garage
Description[0..1] : nlString
service
local
flexible
0..1
1
FlexibleService
FlexibleJourneyPattern[0..*] : FlexibleJourneyPattern
Versionable
patterns
1..*
1
AbstractStopUsage
WaitTime[0..1] : duration
Activity[0..1] : ActivityEnum
DynamicDestinationDisplay[0..1] : nlString
VariableStopAllocations[0..*] : VariableStopAllocations
booking
1
FlexibleJourneyPattern
id[1]
FlexibleStopUsage[0..*] : FlexibleStopUsage
FixedStopPoints[0..*] : JourneyPatternStopUsage
BookingArrangements[0..1] : BookingArrangements
0..*
uses ▸
0..1
1
1
1
stops
*
StopPoint
classification
1
0..*
1 1
0..*
BookingArrangements
Description[1] : nlString
Phone[0..1] : TelephoneNumberType
Email[0..1] : email
Address[0..1] : UkPostalAddress
WebAddress[0..1] : anyURI
AllBookingsTaken[0..1] : boolean
JourneyPatternStopUsage
Id[1] : id
Sequence[0..1] : integer
StopPointRef[1] : StopPointCodeType
TimingStatus[0..1] : TimingStatusEnum
FareStageNumber[0..1] : string
FareStage[0..1] : boolean
zones
StopClassification
0..*
zones
OnStreet
pattern
0..*
AbstractVehicleJourney
0..*
Bus
is at
0..*
FlexibleStopUsage
Activity[0..1] : ActivityEnum
StopPointRef[1] : StopPointCodeType
BusCoachTramPublic[BCT]
1
type
1
BusCoachTramPrivate(BCP)
1..1
FlexibleVehicleJourney
VehicleServiceTimes[1] : FlexibleServiceTimes
«enumeration»
ActivityEnum
pickUp
setDown
pickUpAndSetDown
pass
type
1
available
1
BusStopType
1
1
FlexibleZone[FLX]
FlexibleServiceTimes
AllDayService[0..1] : boolean
ServicePeriod[0..*] : HalfOpenDateRage
times
1
0..*
PeriodsOfOperation
StartTime[1] : dateTime
EndTime[1] : dateTime
polygon
1..1
{ordered}
3..*
1..1
Location

Figure 3-17 – UML Diagram for Flexibly Routed Service

3.8 Interchanges

To specify the connection between vehicle journeys, an Interchange model is used, as shown in the UML structure diagram in *Figure 3-18*. The Interchange model operates on two levels of discourse:

- A ***JourneyPatternInterchange*** specifies a possible connection between any two ***JourneyPattern*** instances, at a particular stop or pair of stops, with default values for the connection activity.
    - A service may hold multiple connections.
    - The arrival stop of the inbound 'feeder to' journey, and the departure stop of the outbound 'distributor from' journey may be different *NaPTAN* stop points, i.e. require a transfer.
    - The mode of transfer (e.g. walk or otherwise) is indicated by a ***TransferMode*** property.

- A ***VehicleJourneyInterchange*** specifies the connection between two specific ***VehicleJourney*** instances, at a ***VehicleJourneyInterchange.*** A vehicle journey connection projects onto an equivalent ***JourneyPatternInterchange***, which constrains it to use the corresponding inbound feeder and outbound distributor journey, and the same stops specified by the ***JourneyPatternInterchange***.
    - A vehicle journey may have connections with more than one other vehicle journey.

Note that inbound 'feeder to' and outbound 'distributor from' are relative roles; and a given service may serve as both feeder and distributor (i.e. passengers may exchange both ways between vehicles); in which case separate interchange instances can be declared for each direction.

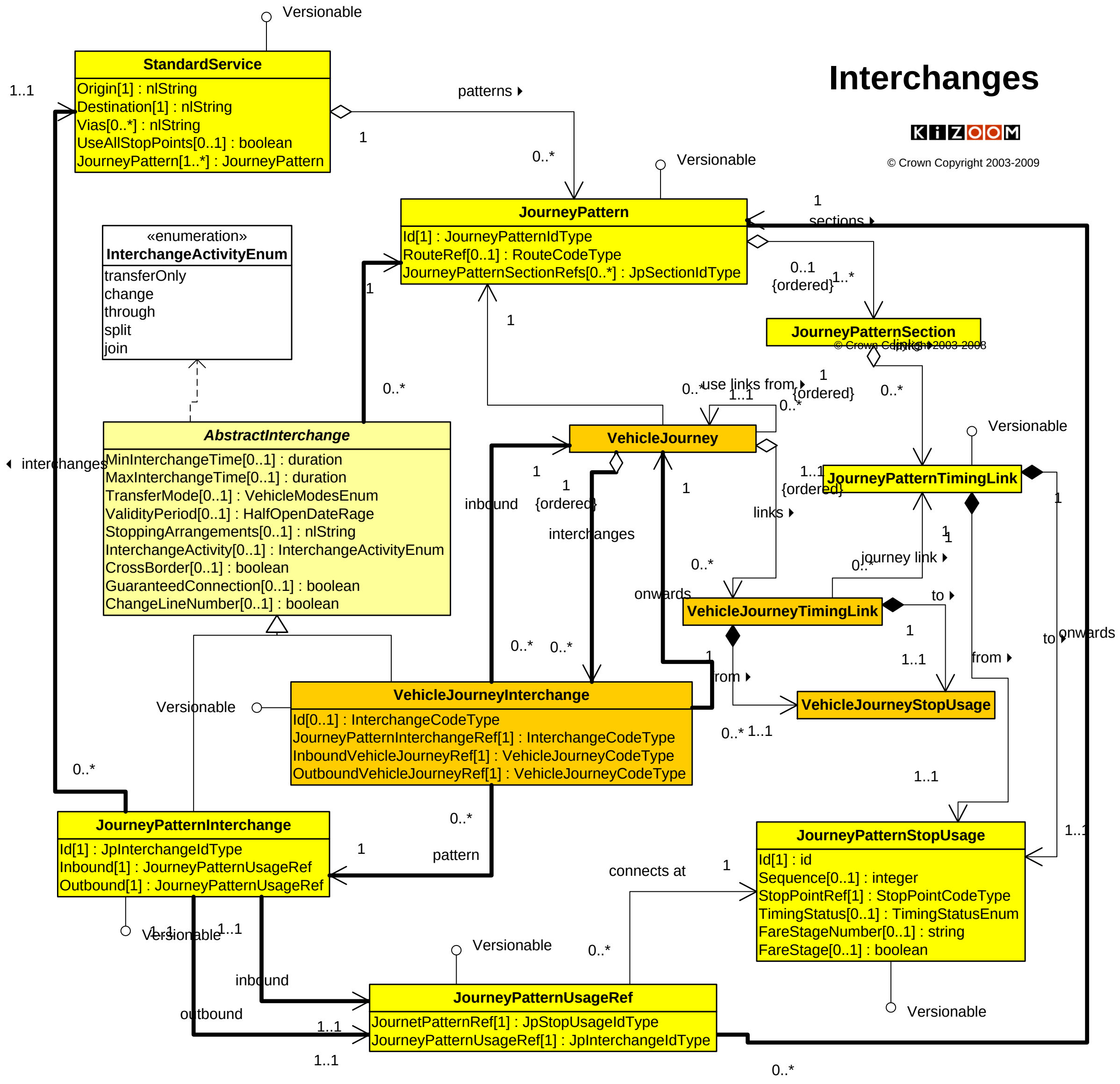

Interchanges
KIZOOM
© Crown Copyright 2003-2009
Versionable
StandardService
Origin[1] : nlString
Destination[1] : nlString
Vias[0..*] : nlString
UseAllStopPoints[0..1] : boolean
JourneyPattern[1..*] : JourneyPattern
1..1
patterns
1
0..*
Versionable
JourneyPattern
Id[1] : JourneyPatternIdType
RouteRef[0..1] : RouteCodeType
JourneyPatternSectionRefs[0..*] : JpSectionIdType
1
sections
0..1
{ordered}
1..*
JourneyPatternSection
links
«enumeration»
InterchangeActivityEnum
transferOnly
change
through
split
join
1
1
0..*
AbstractInterchange
MinInterchangeTime[0..1] : duration
MaxInterchangeTime[0..1] : duration
TransferMode[0..1] : VehicleModesEnum
ValidityPeriod[0..1] : HalfOpenDateRage
StoppingArrangements[0..1] : nlString
InterchangeActivity[0..1] : InterchangeActivityEnum
CrossBorder[0..1] : boolean
GuaranteedConnection[0..1] : boolean
ChangeLineNumber[0..1] : boolean
interchanges
0..* use links from
1..1
1
{ordered}
0..*
0..*
VehicleJourney
Versionable
1..1
JourneyPatternTimingLink
{ordered}
1
1
1
inbound
{ordered}
links
interchanges
1
journey link
0..*
0..*
onwards
VehicleJourneyTimingLink
to
1
onwards
to
0..*
0..*
1
from
1..1
from
Versionable
VehicleJourneyInterchange
Id[0..1] : InterchangeCodeType
JourneyPatternInterchangeRef[1] : InterchangeCodeType
InboundVehicleJourneyRef[1] : VehicleJourneyCodeType
OutboundVehicleJourneyRef[1] : VehicleJourneyCodeType
VehicleJourneyStopUsage
0..* 1..1
0..*
1..1
0..*
JourneyPatternInterchange
Id[1] : JpInterchangeIdType
Inbound[1] : JourneyPatternUsageRef
Outbound[1] : JourneyPatternUsageRef
1
pattern
connects at
1
1..1
JourneyPatternStopUsage
Id[1] : id
Sequence[0..1] : integer
StopPointRef[1] : StopPointCodeType
TimingStatus[0..1] : TimingStatusEnum
FareStageNumber[0..1] : string
FareStage[0..1] : boolean
1..1
Versionable
1..1
Versionable
0..*
inbound
outbound
JourneyPatternUsageRef
JournetPatternRef[1] : JpStopUsageIdType
JourneyPatternUsageRef[1] : JpInterchangeIdType
1..1
1..1
Versionable
0..*

Figure 3-18 – UML Diagram of Interchanges

3.8.1 Inheriting Interchange Values

Table 3-6 shows the various values that may be specified for the ***JourneyPatternInterchange*** and ***VehicleJourneyInterchange*** elements, and whether they are:

(i) **Required** ('R').
(ii) **Optional** but otherwise inherited from the previous level of discourse ('O').
(iii) Always **Inherited**. ('I').

For elements that are optional at all levels, a default value is identified to use if no explicit value is provided.

Level	Property	*Journey Pattern*	*Vehicle Journey*	Default Value
Interchange	***InboundJourneyPatternRef***	**R**	I	--
	OutboundJourneyPatternRef	**R**	I	--
	InboundStopUsageRef	**R**	I	--
	OutboundStopUsageRef	**R**	I	--
	InterchangeActivity	**O**	O	*change*
	MinInterchangeTime	**R**	O	--
	MaxInterchangeTime	**O**	O	*Zero*
	InterchangeMode	O	I	*walk*
	ValidityPeriod	O	O	*service end date*
	StoppingArrangements	O	O	*none*
	InboundVehicleJourneyRef	-	**R**	--
	OutboundVehicleJourneyRef	-	**R**	--

Table 3-9 – Interchange Properties and Defaults

3.8.2 Interchange Schematic

Figure 17 shows a schematic diagram of an interchange between two journeys. The inbound feeder journey arriving at stop '*A*' from stop '*X*' connects to a second distributor journey from stop '*A*' onto stop '*B*'. The journey pattern interchange links the stop usages of the two journey patterns. The vehicle journey interchange links the two vehicle journeys.

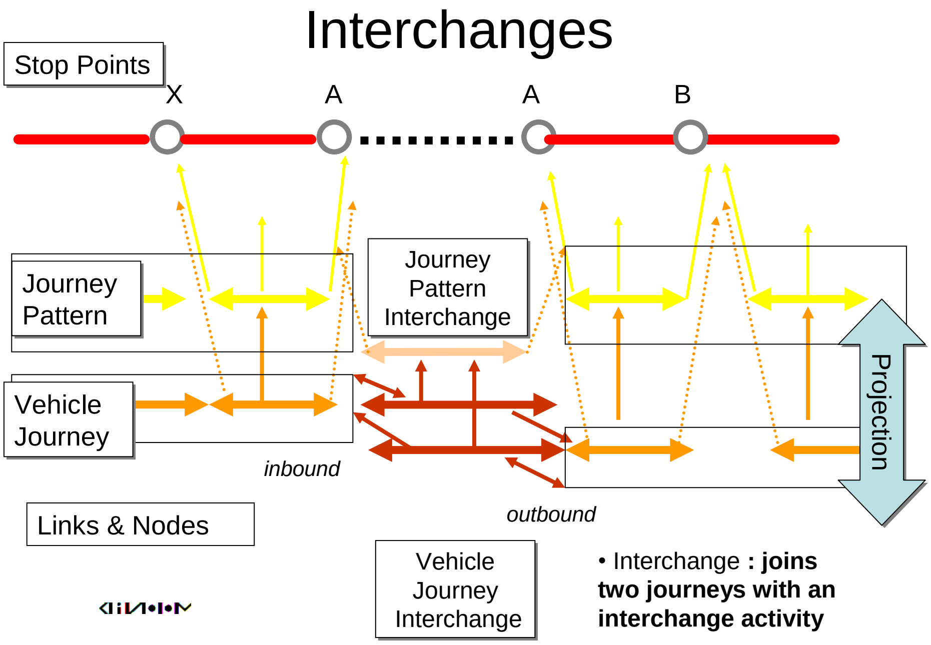

Interchanges
Stop Points
X
A
A
B
Journey Pattern
Journey Pattern Interchange
Vehicle Journey
inbound
outbound
Projection
Links & Nodes
Vehicle Journey Interchange
• Interchange : joins two journeys with an interchange activity

Figure 3-19 – Interchange Links

3.8.3 Interchange Instance Example

As a pictorial example of a connection, *Figure 3-20* shows a UML instance diagram of the element instances for a connection between two vehicle journeys:

- At the top, in yellow, can be seen a ***Service*** with two journey patterns, one inbound feeder to a ***JourneyPatternInterchange,*** and one outbound distributor from it. Each ***JourneyPattern*** has a single ***JourneyPatternSection*** containing a sequence of timing links; only the last ***JourneyPatternTimingLink*** of the inbound feeder journey pattern, and the first ***JourneyPatternTimingLink*** of the outbound distributor journey pattern are shown, along with the ***VehicleJourneyStopUsage*** instance for each end of the link.

- The ***JourneyPatternInterchange*** instance references both inbound feeder and outbound distributor journey patterns. It also references the destination ***VehicleJourneyStopUsage*** instance of the last timing link of the inbound feeder pattern, and the origin ***VehicleJourneyStopUsage*** of the last timing link of the outbound distributor pattern.

- Below this, in orange, can be seen two corresponding inbound feeder and outbound distributor ***VehicleJourney*** instances. Again, only the last ***VehicleJourneyTimingLink*** of the inbound feeder vehicle journey, and the first ***VehicleJourneyTimingLink*** of the outbound distributor vehicle journey are shown.

- .Each ***VehicleJourneyTimingLink*** individually projects onto the appropriate ***JourneyPatternTimingLink*** instance by an explicit reference.

- Each vehicle journey has its own instance of a ***VehicleJourneyInterchange,*** which references both the inbound feeder and outbound distributor vehicle journey instances. It also references the ***JourneyPatternInterchange*** that connects the journey patterns upon which the vehicle journeys are based.

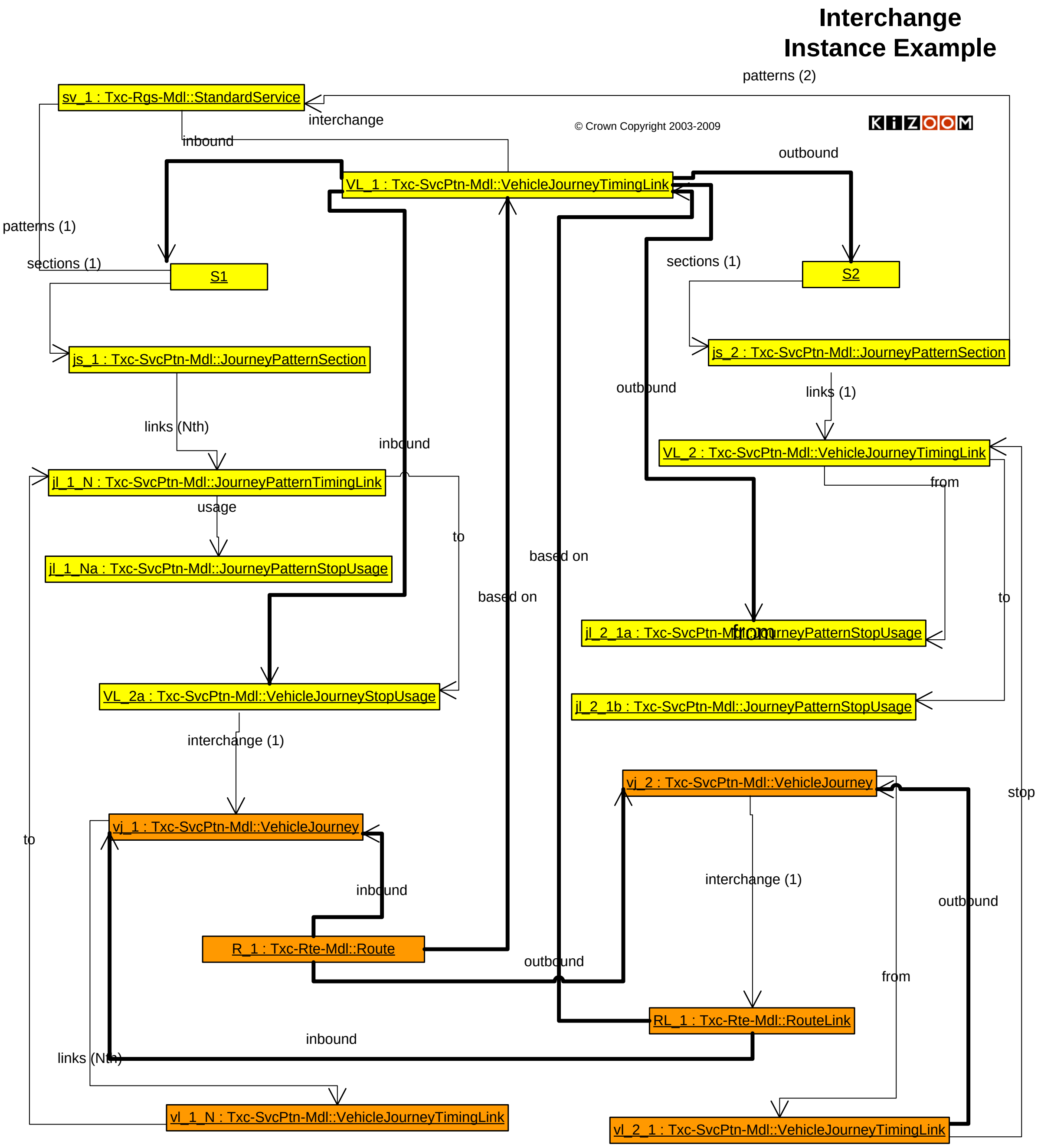

Interchange Instance Example
patterns (2)
sv_1 : Txc-Rgs-Mdl::StandardService
interchange
inbound
© Crown Copyright 2003-2009
KIZOOM
outbound
VL_1 : Txc-SvcPtn-Mdl::VehicleJourneyTimingLink
patterns (1)
sections (1)
S1
sections (1)
S2
js_1 : Txc-SvcPtn-Mdl::JourneyPatternSection
js_2 : Txc-SvcPtn-Mdl::JourneyPatternSection
outbound
links (1)
links (Nth)
inbound
VL_2 : Txc-SvcPtn-Mdl::VehicleJourneyTimingLink
jl_1_N : Txc-SvcPtn-Mdl::JourneyPatternTimingLink
from
usage
to
based on
jl_1_Na : Txc-SvcPtn-Mdl::JourneyPatternStopUsage
based on
to
jl_2_1a : Txc-SvcPtn-Mdl::JourneyPatternStopUsage
from
VL_2a : Txc-SvcPtn-Mdl::VehicleJourneyStopUsage
jl_2_1b : Txc-SvcPtn-Mdl::JourneyPatternStopUsage
interchange (1)
vj_2 : Txc-SvcPtn-Mdl::VehicleJourney
stop
vj_1 : Txc-SvcPtn-Mdl::VehicleJourney
to
interchange (1)
inbound
outbound
R_1 : Txc-Rte-Mdl::Route
outbound
from
RL_1 : Txc-Rte-Mdl::RouteLink
inbound
links (Nth)
vl_1_N : Txc-SvcPtn-Mdl::VehicleJourneyTimingLink
vl_2_1 : Txc-SvcPtn-Mdl::VehicleJourneyTimingLink

Figure 3-20 – UML Instance Diagram of Example Interchange

3.9 Fare Stages

TransXChange supports the annotation of links with basic fare stage data for operational purposes. There are two different models commonly used for fare stages:

1. A **Stage Fare** model, where the fare stage is located on a boundary between two zones and is considered to be in both zones. In effect the fare stage is on the stop point, but only applies to journeys (i.e. sequences of links) where the other end of two subsequent links is in different zones.
2. A **Zonal** model, where the fare stage boundary lies between two stops, each within a distinct fare zone. The fare stage is in effect on the link between the stops. Only journeys going in the direction of the other zone and that cross the boundary will encounter the fare stage.

In the *TransXChange* model, fare stages are a property of timing link stop usage, so that both Stage Fare and Zonal models can be supported. Fare stage values can be specified at both the journey pattern and vehicle journey level of discourse as a successive property, that is one that carries onto succeeding links in the series until reset.
The fare stage change occurs at the point of pick up, that is, at the originating end of the link, as shown in *Figure 3-21,* which shows examples of link sequences over a zone boundary for both fare models, with fare stage numbers and fare stage points marked. Whether a stop usage for a given link is a fare stage is properly determined by whether the ***FareStageNumber*** changes when traversing a sequence of timing links: the ***FareStage*** indicator can be used to store a statically computed determination of this property for convenience of implementation.

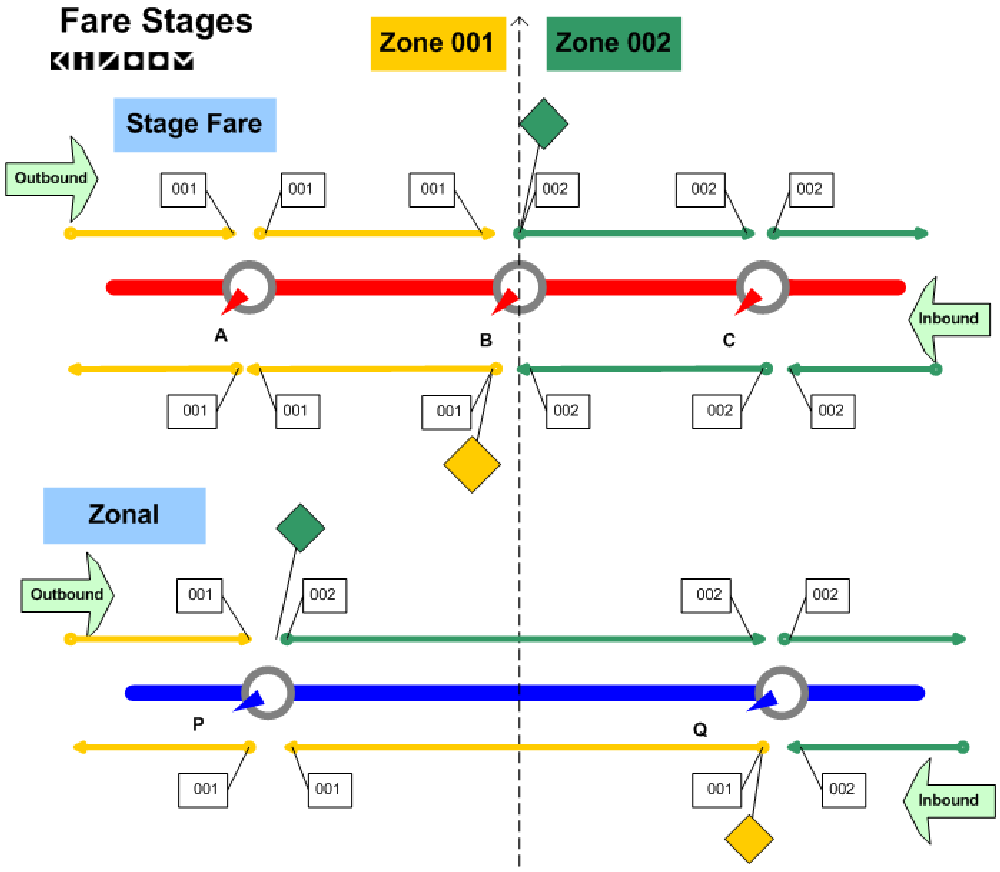


Figure 3-21 – Fare Stages & Links

3.10 Dead Runs

'Dead run' or positioning runs may be specified on vehicle journeys to describe how vehicles are placed in position to deliver a service, and also how they are retrieved after completing the service. Dead run positioning links are primarily of use for exchanging information for AVL systems, and are not needed for registration or publishing schedules. Dead runs can also be used to indicate short working. *Figure 3-22* shows a UML structure diagram of the elements used to describe dead runs.

- A ***VehicleJourney*** may have an initial ***StartDeadRun*** and a final ***EndDeadRun***.
- Each ***DeadRun*** consists of one or more ***PositioningLink*** instances.
  - Each ***PositioningLink*** runs between two position points, which may be specified as either a ***Location***, a ***StopPoint***, a ***LayoverPoint*** or a ***Garage***.
  - A ***DeadRun*** may reference a ***VehicleJourneyTimingLink*** to indicate the point at which short working starts or stops.

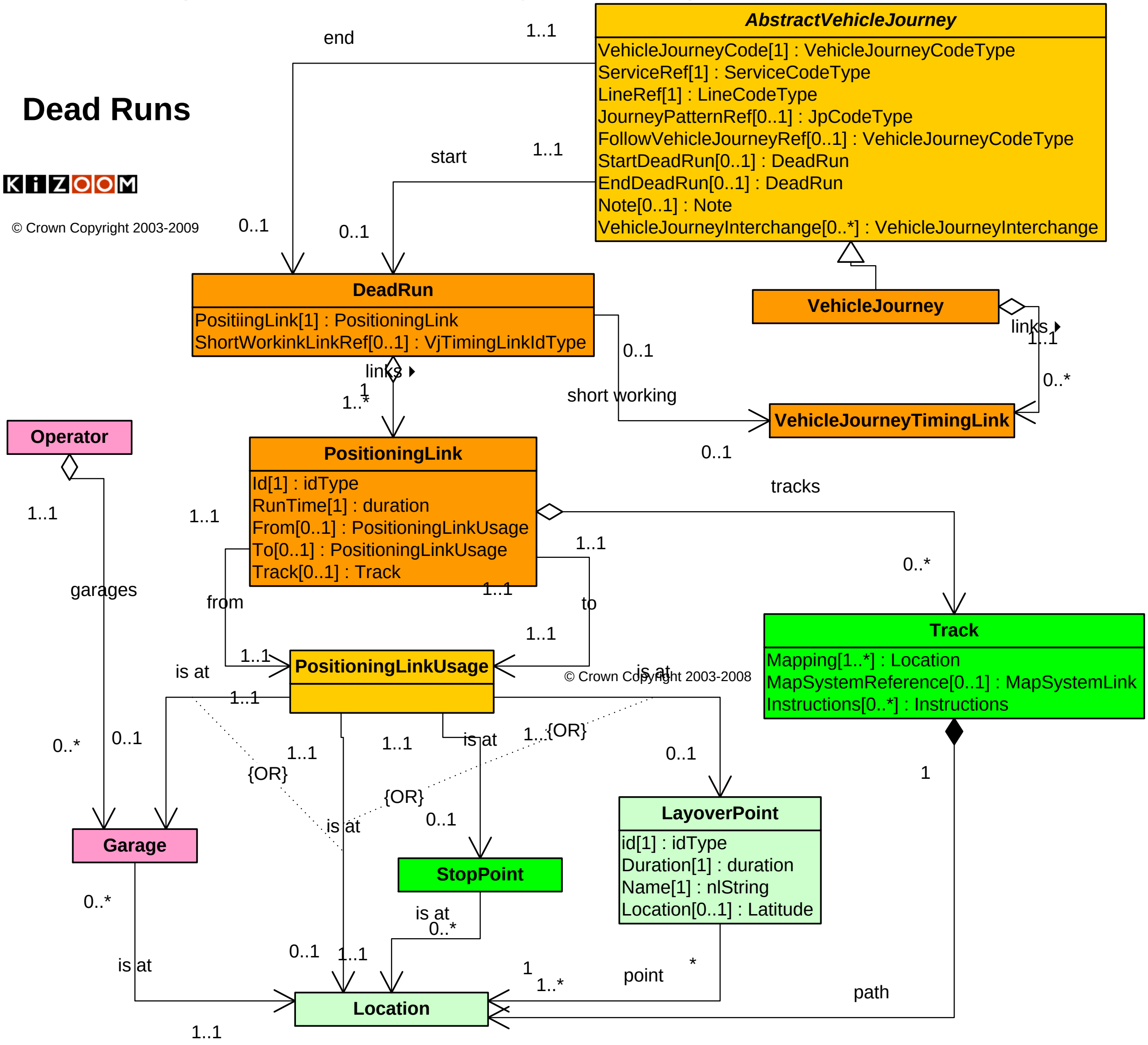

Dead Runs
KIZOOM
© Crown Copyright 2003-2009
AbstractVehicleJourney
VehicleJourneyCode[1] : VehicleJourneyCodeType
ServiceRef[1] : ServiceCodeType
LineRef[1] : LineCodeType
JourneyPatternRef[0..1] : JpCodeType
FollowVehicleJourneyRef[0..1] : VehicleJourneyCodeType
StartDeadRun[0..1] : DeadRun
EndDeadRun[0..1] : DeadRun
Note[0..1] : Note
VehicleJourneyInterchange[0..*] : VehicleJourneyInterchange
end
1..1
start
1..1
0..1
0..1
DeadRun
PositiingLink[1] : PositioningLink
ShortWorkinkLinkRef[0..1] : VjTimingLinkIdType
VehicleJourney
links
1..1
0..*
0..1
short working
VehicleJourneyTimingLink
links
1
1..*
Operator
PositioningLink
Id[1] : idType
RunTime[1] : duration
From[0..1] : PositioningLinkUsage
To[0..1] : PositioningLinkUsage
Track[0..1] : Track
0..1
tracks
1..1
1..1
1..1
0..*
garages
from
1..1
to
Track
Mapping[1..*] : Location
MapSystemReference[0..1] : MapSystemLink
Instructions[0..*] : Instructions
is at
1..1
PositioningLinkUsage
1..1
© Crown Copyright 2003-2008
is at
1..1
0..*
0..1
1..1
1..1
is at
1..{OR}
0..1
{OR}
{OR}
1
is at
0..1
Garage
StopPoint
LayoverPoint
id[1] : idType
Duration[1] : duration
Name[1] : nlString
Location[0..1] : Latitude
0..*
is at
0..*
is at
0..1
1..1
1
1..*
point
*
path
Location
1..1

Figure 3-22 – UML Diagram of Dead Run Model

3.10.1 Use of Dead Runs for Short Working

Dead runs may be used to indicate that a Vehicle Journey starts or ends at a particular point in a journey pattern, omitting all links & stops before or after the intercept point. See the *Circular Route* example for an illustration of both short and full workings of the same route.

3.11 Tracks

The *TransXChange* Track model describes details about the physical course of a ***RouteLink,*** in particular the collection of spatial points needed to plot the route unambiguously in sequence on a map of the road network, for example using a 'snap to track' algorithm. As well as such a ***Mapping***, a ***Track*** can also be associated with a reference to an external mapping system using a ***MapSystemReference*** element, allowing the projection of links onto mapping layers. Track features can also be used to describe any manoeuvre involved in navigating a route link, such as a U-turn.
The Track model allows a rich description of a route to be provided; it is intended for general purpose data exchange. For a Registration a level of Track detail should be given sufficient to unambiguously plot the route on a map using OSGR data – using both points and/or TOIDS.

It is a requirement of registration that adequate spatial data is provided as to plot routes on an OS map in a useful way: there should be intermediate coordinates for a reasonably high level of resolution.

Figure 3-23 shows a UML structure diagram of the elements used to describe tracks. Tracks can contain two different types of description:

- A ***Mapping*** describes the geospatial plot of the route link as two or more ***Location*** elements that provide point coordinates for the track between *NaPTAN* stop points.
- An ***Instructions*** instance provides an optional additional structured description of the steps involved in traversing the track as a sequence of ***Feature*** instances. For example '*Turn left at roundabout into Mary Street*'.

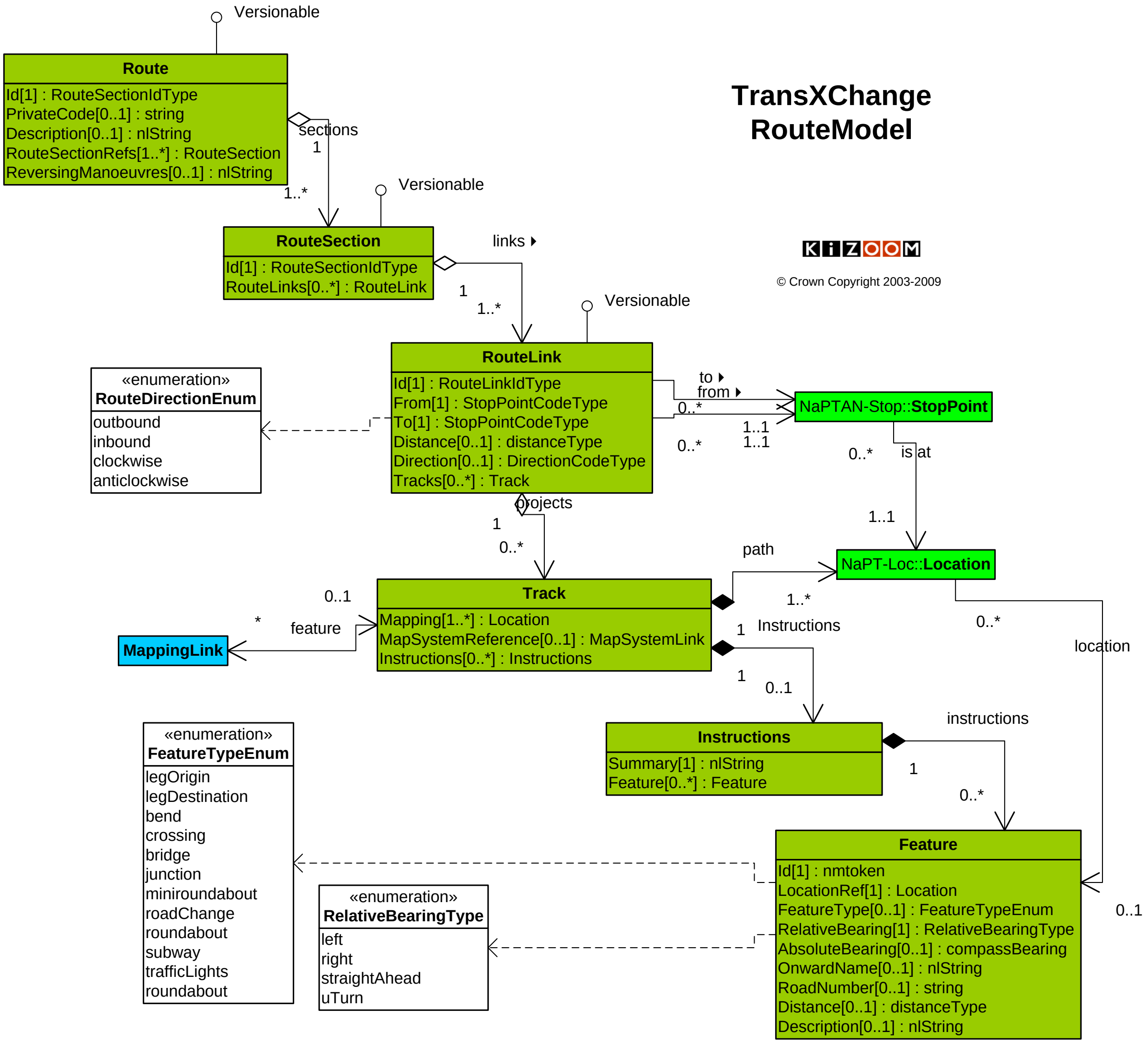


Figure 3-23 – UML Diagram of Track Model

3.11.1 Track Model

As a simple example, consider a ***RouteLink*** that runs along the B205 and B257, represented by a two ***Track*** instances.

- Each ***Track*** instance has a ***Mapping*** instance that describes the course of the track. tr1 has two points (g_1, g_2)) and tr2 has seven points (g_3 to g_7) respectively; each point is a ***Location*** instance that describes a point of the track.

- Each ***Track*** has an ***Instructions*** instance containing an ordered collection of ***Feature*** instances.

- Each ***Feature*** instance describes a step needed to traverse the track, and references a ***Location*** instance from the ***Mapping***. *Table 3-10* shows a sample of the ***Feature*** instances.

Track	Location Ref	Feature Type	Relative Bearing	Absolute Bearing	Onward Name	Road Number	Dist-ance	Description
Tr1	*G_1*	*legOrigin*	*straightAhead*	*N*	*Victoria Road*	*B205*	*300m*	*Proceed 300m North down Victoria road (B205.)*
	G_2	*junction*	*left*	*W*	*Albert Road*	*B205*	*500m*	*Turn left into Albert road (B257) and head west 500m.*
Tr2	*G_3*	*landmark*	*straightAhead*	*--*	*--*		*--*	*Hospital on left*
	G_4	*bend*	*right*	*NW*	*Albert Road*	*B257*	*--*	*Follow bend to right in Albert Road*
	G_5	*roadChange*	*straightAhead*	*NW*	*George Road*	*B257*	*400m*	*Continue 400m down George Road (B257)*
	G_6	*roundabout*	*left*	*SW*	*Mary Street*	*B257*	*--*	*Turn left at roundabout into Mary Street*
	G_7	*crossing*	*straightAhead*	*--*	*Bill Alley*	*B257*	*--*	*Cross over Bill Alley*
	G_8	*bridge*	*straightAhead*	*--*	*Mary Street*	*B257*	*--*	*Pass under bridge*
	G_9	*legDestination*	*straightAhead*	*S*	*Mary Street*	*B257*	*600m*	*Continue straight ahead 600m South down Mary Street*

Table 3-10 – Example Track Instructions

3.12 The Registration Model

The statutory requirements of a bus registration are captured in *TransXChange Registration* by a small submodel of descriptive elements associated with a service, as outline in the UML structure diagram in *Figure 3-24* and elaborated in Figure 3-25

- A TransXChange document can contain ***Registration*** elements:
  - A *TransXChange Registration* document <u>must</u> contain one ***Registration*** instance.
  - A *TransXChange General* document <u>may</u> contain one or more ***Registration*** instances.

- A single ***Service*** can be associated with each ***Registration***.
  - A *TransXChange Registration* document ***Registration*** <u>must</u> contain a ***Service*** instance that references the ***Registration***. It may have other ***Service*** definitions for connecting services.
  - A *TransXChange General* document <u>may</u> contain a ***Service*** instance.

- A ***Service*** has a ***RegisteredOperator,*** and may have additional ***AssociatedOperator*** instances. Operators may be instances of either ***LicensedOperator*** or ***Operator.***
  - In a *TransXChange Registration,* the ***RegisteredOperator*** <u>must</u> be a ***LicensedOperator*** instance, with all details completed. (Note this constraint is enforced by an XML keyref).
  - In a *TransXChange General* document the ***RegisteredOperator*** <u>may</u> be an instance of either ***LicensedOperator*** or ***Operator.***

- A ***Registration*** records the ***TrafficAreaNetwork*** and ***CirculatedAuthority*** instances.
  - Additional special details can be recorded for a ***ShortNoticeRegistration,*** including references to other services that the service replaces, or to which it connects. A short notice registration is an application to register, cancel or change a service made with less than the normally required 56 days' period of notice.
  - The ***Registration*** can be annotated with ***SupportingDocument*** instances that identify related documents.

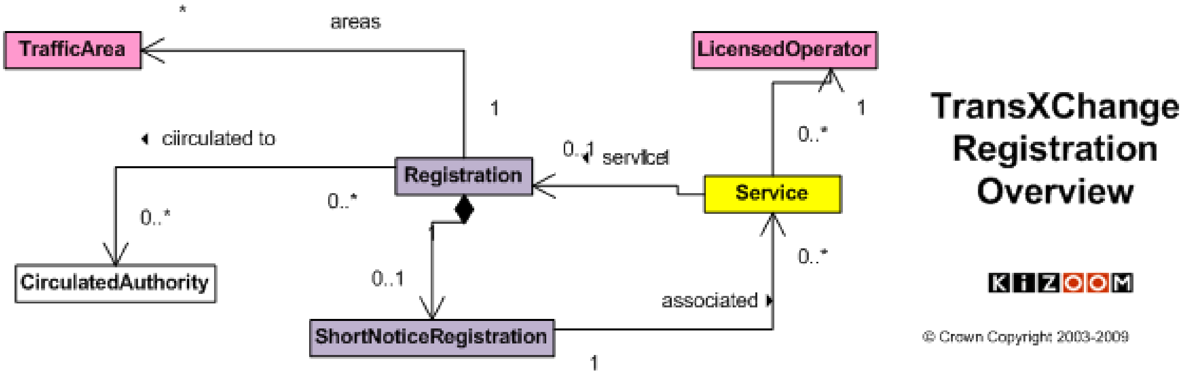


Figure 3-24 – UML Diagram of Basic Registration Model

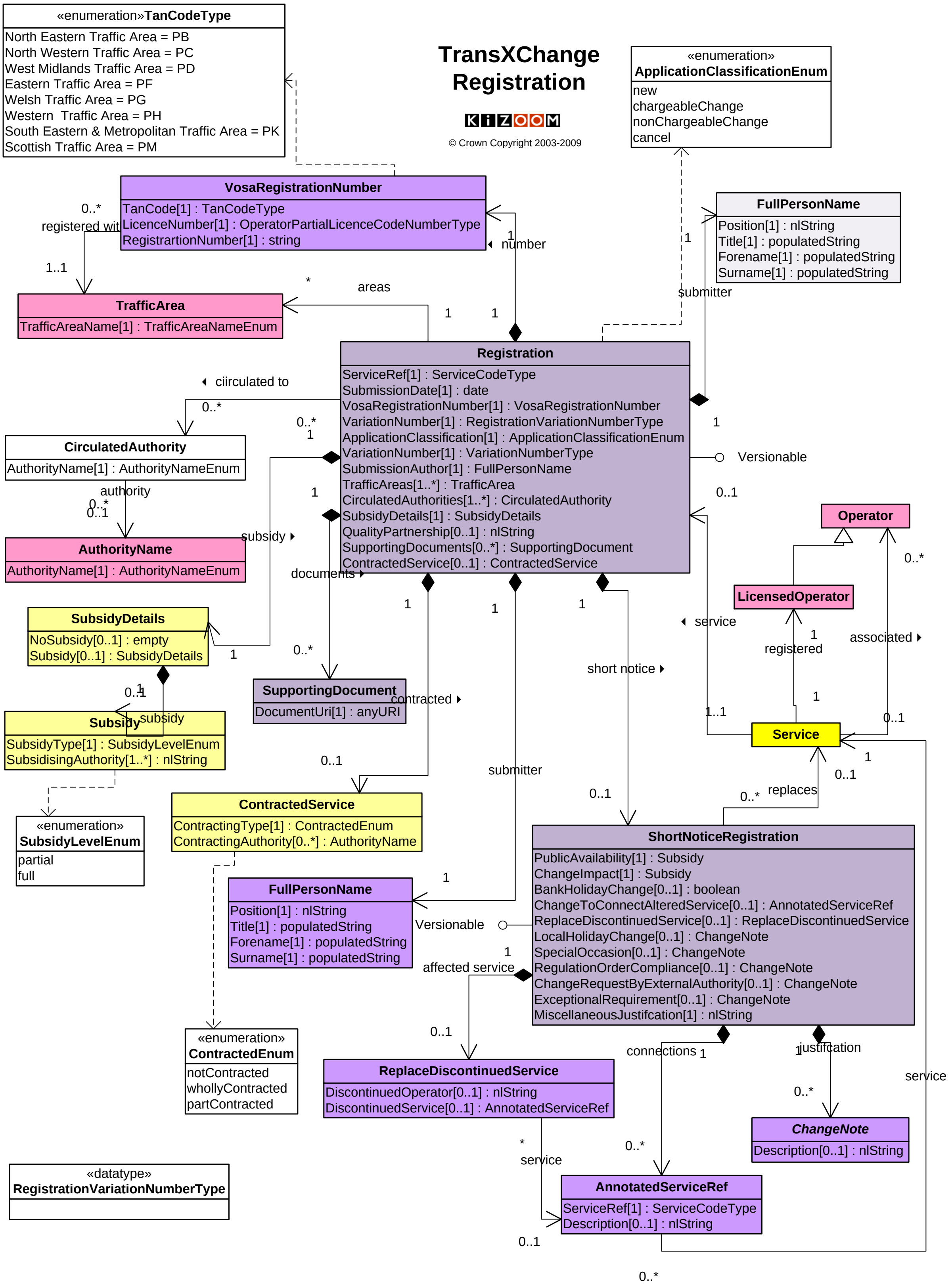

TransXChange
Registration
KIZOOM
© Crown Copyright 2003-2009
«enumeration»TanCodeType
North Eastern Traffic Area = PB
North Western Traffic Area = PC
West Midlands Traffic Area = PD
Eastern Traffic Area = PF
Welsh Traffic Area = PG
Western Traffic Area = PH
South Eastern & Metropolitan Traffic Area = PK
Scottish Traffic Area = PM
«enumeration»
ApplicationClassificationEnum
new
chargeableChange
nonChargeableChange
cancel
VosaRegistrationNumber
TanCode[1] : TanCodeType
LicenceNumber[1] : OperatorPartialLicenceCodeNumberType
RegistrartionNumber[1] : string
0..*
registered wit
1..1
1
number
FullPersonName
Position[1] : nlString
Title[1] : populatedString
Forename[1] : populatedString
Surname[1] : populatedString
1
submitter
*
areas
TrafficArea
TrafficAreaName[1] : TrafficAreaNameEnum
1
1
Registration
ServiceRef[1] : ServiceCodeType
SubmissionDate[1] : date
VosaRegistrationNumber[1] : VosaRegistrationNumber
VariationNumber[1] : RegistrationVariationNumberType
ApplicationClassification[1] : ApplicationClassificationEnum
VariationNumber[1] : VariationNumberType
SubmissionAuthor[1] : FullPersonName
TrafficAreas[1..*] : TrafficArea
CirculatedAuthorities[1..*] : CirculatedAuthority
SubsidyDetails[1] : SubsidyDetails
QualityPartnership[0..1] : nlString
SupportingDocuments[0..*] : SupportingDocument
ContractedService[0..1] : ContractedService
ciirculated to
0..*
0..*
1
1
Versionable
0..1
CirculatedAuthority
AuthorityName[1] : AuthorityNameEnum
authority
0..*
0..1
1
subsidy
AuthorityName
AuthorityName[1] : AuthorityNameEnum
documents
Operator
0..*
LicensedOperator
service
associated
1
registered
SubsidyDetails
NoSubsidy[0..1] : empty
Subsidy[0..1] : SubsidyDetails
1
1
1
1
0..*
short notice
1
0..1
1
subsidy
Subsidy
SubsidyType[1] : SubsidyLevelEnum
SubsidisingAuthority[1..*] : nlString
SupportingDocument
DocumentUri[1] : anyURI
contracted
1..1
Service
0..1
1
0..1
0..1
submitter
0..1
0..*
replaces
«enumeration»
SubsidyLevelEnum
partial
full
ContractedService
ContractingType[1] : ContractedEnum
ContractingAuthority[0..*] : AuthorityName
ShortNoticeRegistration
PublicAvailability[1] : Subsidy
ChangeImpact[1] : Subsidy
BankHolidayChange[0..1] : boolean
ChangeToConnectAlteredService[0..1] : AnnotatedServiceRef
ReplaceDiscontinuedService[0..1] : ReplaceDiscontinuedService
LocalHolidayChange[0..1] : ChangeNote
SpecialOccasion[0..1] : ChangeNote
RegulationOrderCompliance[0..1] : ChangeNote
ChangeRequestByExternalAuthority[0..1] : ChangeNote
ExceptionalRequirement[0..1] : ChangeNote
MiscellaneousJustifcation[1] : nlString
1
FullPersonName
Position[1] : nlString
Title[1] : populatedString
Forename[1] : populatedString
Surname[1] : populatedString
Versionable
1
affected service
0..1
connections
1
1
justifcation
service
«enumeration»
ContractedEnum
notContracted
whollyContracted
partContracted
ReplaceDiscontinuedService
DiscontinuedOperator[0..1] : nlString
DiscontinuedService[0..1] : AnnotatedServiceRef
0..*
ChangeNote
Description[0..1] : nlString
*
service
0..*
AnnotatedServiceRef
ServiceRef[1] : ServiceCodeType
Description[0..1] : nlString
«datatype»
RegistrationVariationNumberType
0..1
0..*

Figure 3-25 – UML Diagram of TransXChange Registration

3.12.1 Populating a Registration

Although it is legitimate for a Single Registered Service to have a number of journey pattern variants, the variation should be less than 50% of the primary journey pattern; i.e. *more than 50% of the mileage of the journeys should be in common, i.e. consist of vehicle journeys with timing links that visit or pass the same stops in the same order.*

3.13 Operators

TransXChange includes a basic representation of an ***Operator*** for use in ***Registrations*** see Figure 3-26. An operator may have Garages associated with them.

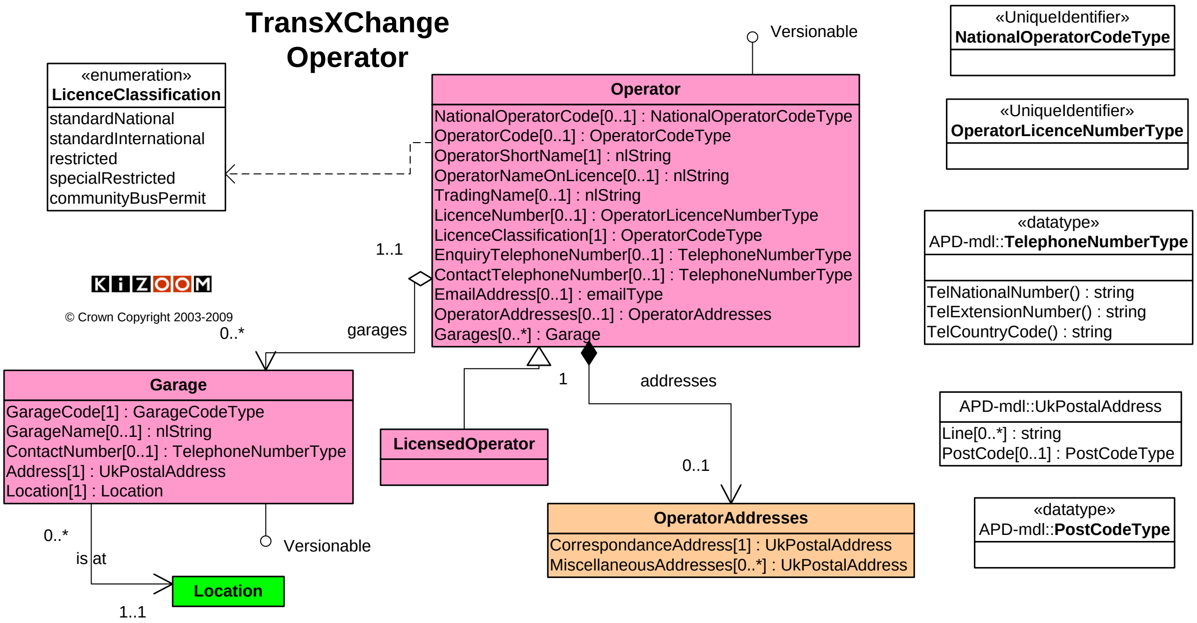

TransXChange Operator
«enumeration» LicenceClassification
standardNational
standardInternational
restricted
specialRestricted
communityBusPermit
Versionable
Operator
NationalOperatorCode[0..1] : NationalOperatorCodeType
OperatorCode[0..1] : OperatorCodeType
OperatorShortName[1] : nlString
OperatorNameOnLicence[0..1] : nlString
TradingName[0..1] : nlString
LicenceNumber[0..1] : OperatorLicenceNumberType
LicenceClassification[1] : OperatorCodeType
EnquiryTelephoneNumber[0..1] : TelephoneNumberType
ContactTelephoneNumber[0..1] : TelephoneNumberType
EmailAddress[0..1] : emailType
OperatorAddresses[0..1] : OperatorAddresses
Garages[0..*] : Garage
«UniqueIdentifier» NationalOperatorCodeType
«UniqueIdentifier» OperatorLicenceNumberType
«datatype» APD-mdl::TelephoneNumberType
TelNationalNumber() : string
TelExtensionNumber() : string
TelCountryCode() : string
KIZOOM
© Crown Copyright 2003-2009
1..1
0..*
garages
Garage
GarageCode[1] : GarageCodeType
GarageName[0..1] : nlString
ContactNumber[0..1] : TelephoneNumberType
Address[1] : UkPostalAddress
Location[1] : Location
1
addresses
LicensedOperator
0..1
OperatorAddresses
CorrespondanceAddress[1] : UkPostalAddress
MiscellaneousAddresses[0..*] : UkPostalAddress
APD-mdl::UkPostalAddress
Line[0..*] : string
PostCode[0..1] : PostCodeType
«datatype» APD-mdl::PostCodeType
0..*
is at
Versionable
Location
1..1

Figure 3-26 – UML Diagram of TransXChange Operator Model

3.14 Further Modelling Topics

3.14.1 Direction: Handling Inbound and Outbound Schedules.

A Service may contain both inbound and outbound journeys, comprising in effect two distinct timetables for the two directions. Normally completely separate routes will be specified for each direction, because there are typically separate NaPTAN points for bus stop pairs each side of the road; routes will therefore be following a different sequence of stops along slightly different road sections. However, there are scenarios where the route (and associated sequence of stops) in one direction is an exact reversal of the route (and associated sequence of stops) in the opposite direction. In this case it is possible to share the route definitions for both directions of a service, as follows (*Figure 3-27*).

1. Each Route contains one or more route sections, each containing a sequence of route links. Each route link is flagged as *Outbound, Inbound, Clockwise* or *Anticlockwise*. All the links within a route section must be in the same direction.

2. At least one journey pattern is specified for each direction of the Route. The journey pattern sections contain journey pattern timing links in the order of traversal, each of which can specify a direction (if a direction is not specified the direction will be assumed to be the same as that of any route link which the timing link references).

- If the direction of a journey pattern timing link is the **same** as that of the route link which it references, then the stops referenced in the from and to stop usages of the timing link will be the same as for the route link, and the timing links will appear in the same order as the route links.
    - For example, if (a) Route Link '*RL_1'* goes from '*A'* to '*B'* with a direction of '*outbound'*, and (b) Route Link '*RL_2'* goes from '*B'* to '*C',* also with a direction of '*outbound'*, then the <u>outbound</u> journey pattern would have two outbound journey pattern timing links: (i) '*JTL_1'* which references '*RL_1'* with a direction of '*outbound'*, and also runs from '*A'* to '*B'*, followed by (ii) journey pattern timing link '*JTL_2'*, which references '*RL_2, and* goes from '*B'* to '*C'.'* Note that in this discussion; 'A', 'B', etc refer to stop pairs: in actuality, the inbound and outbound stops are likely to be distinct stops of a pair either side of the road. So actually the NaPTAN stops of inbound and outbound routes and journey pattern will be quite distinct.
- If the direction of the of a journey pattern timing link is the **opposite** to that of the route link which it references, then both the link order, and the stops referenced in the from and to stop usages will be reversed.
    - For example, if (a) Route Link '*RL_1'* goes from '*A'* to '*B'* with a direction of '*outbound'*, and (b) Route Link '*RL_2'* goes from '*B'* to '*C',* also with a direction of '*outbound'*, then the <u>inbound</u> journey pattern would have two inbound journey pattern timing links: (i) journey pattern timing link '*JTL_X1,'* which references '*RL_2'* but which runs from 'C*'* to 'B*',* and (ii) journey pattern timing link '*JTL_X2,'* which references '*RL_1'* but which runs from 'B*'* to 'A*'.*

3. Each vehicle journey follows the same direction as the journey pattern that it references.

4. The Service may be given an overall Direction: this may be one of *Inbound, Outbound, InboundAndOutbound, Clockwise, Anticlockwise*, or *Circular*.

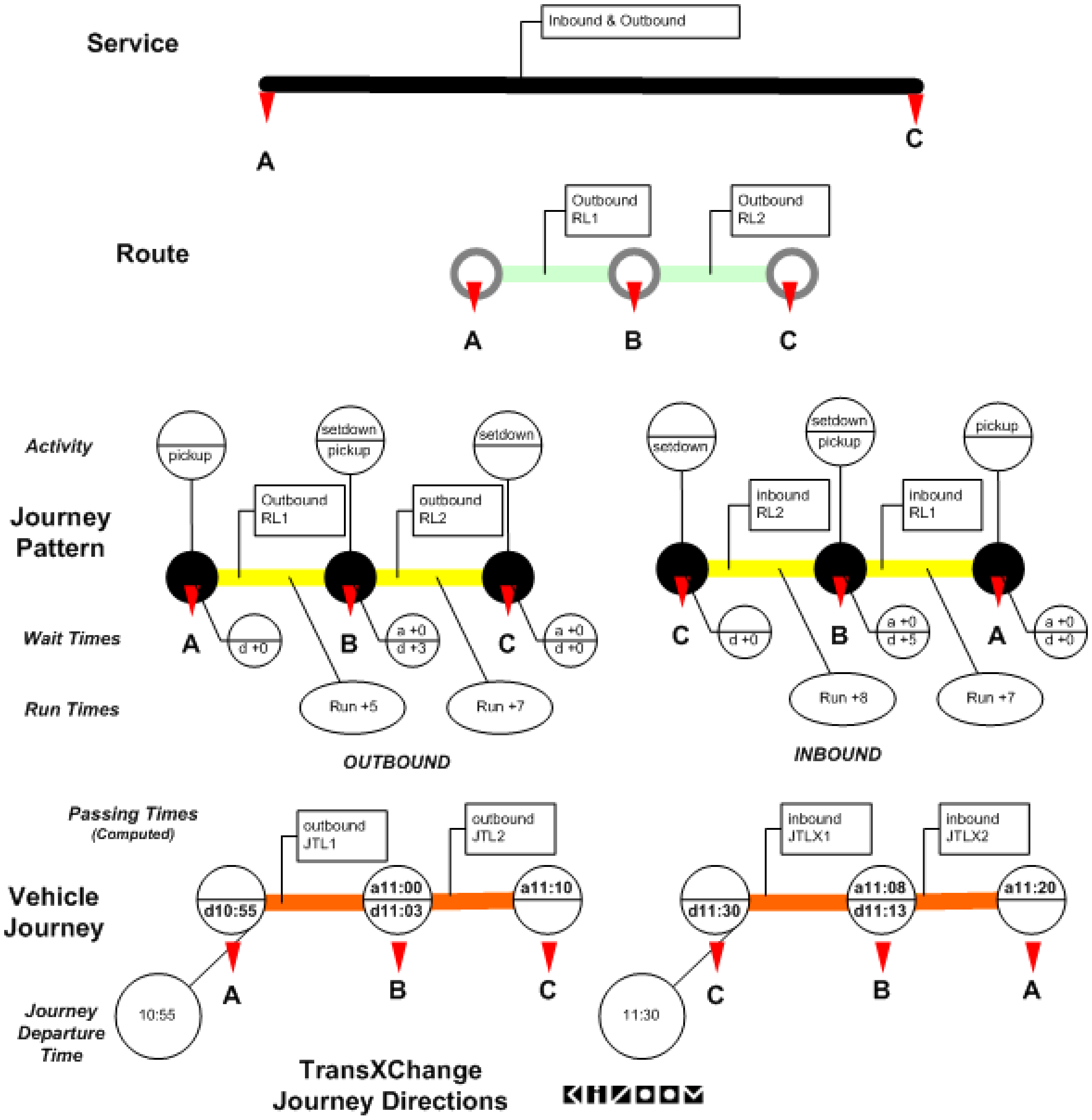


Figure 3-27 – Journey Directions

The *TransXChange Publisher* will sort the vehicle journeys of a service into distinct outbound and inbound groups, and create a separate matrix for each direction.

3.14.2 Modelling Complex Routes

The *TransXChange* model can be used to represent complex services, for example:

- Services with topologically complex routes.
- Services with complex temporal operational patterns.

3.14.2.1 Services with Topologically Complex Routes

The *TransXChange* model can be used to represent complex patterns of service:

1. **Repeated stop routes.** *Circular* (*Figure 3-28*), *Lollipop* (*Figure 3-29*) and *Cloverleaf* (*Figure 3-30*) routes involve visiting the same stop more than once within a single vehicle journey. In the *TransXChange* model, each link has a separate identity in both the route, journey pattern and vehicle journey link sequences, so it is possible to distinguish the separate link traversals and occurrences of a stop in a journey, and so to compose complex routes, and also to project unambiguously the links of such routes between the route, journey pattern and vehicle journey level of discourse. (In *TransXChange* 1.2 this was not always possible). Other features helpful in representing complex routes are:
   - **Dynamic destination displays**, so that bus headings can change over the course of the route.
   - Reusable route and journey pattern **sections**, so that definitions of sections of the route and/or journey pattern may be shared between different journeys. See ‘Modelling Services Efficiently’ below.
   - Stop **Sequence numbers** – so that the presentation of a route in a matrix can be exactly controlled. See ‘Presenting Schedules in Timetables’ below.

2. **Multiple route variants**. Complex services may be composed of multiple route and journey pattern variations, involving either covering different branches of the physical network, or traversing subsets of the full stop sequence, or both.
   - ***Line*** elements can be used to separate the *modelling* of the network topology as routes and journey patterns, from the *labelling* of the network services with public identifiers on vehicle journeys – which is done using the ***Line*** / ***LineName*** element. Thus several different route variants may all be grouped under the same line name.
   - ***RouteSection*** elements can be used to model reusable subsections and branches of the route network, and ***JourneyPatternSection*** elements can be used to annotate this substructure with timing values, allowing for the representation and reuse of the route substructure.

3. **Connecting routes**. The connections between routes services may be described using ***JourneyPatternInterchange*** and ***VehicleJourneyInterchange*** elements.

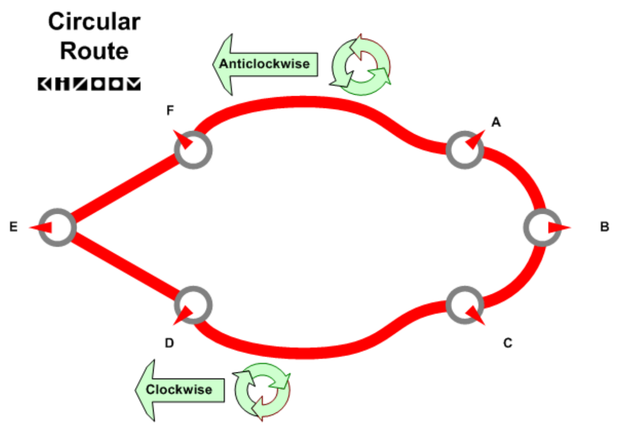


Figure 3-28 – Topology: Circular Route

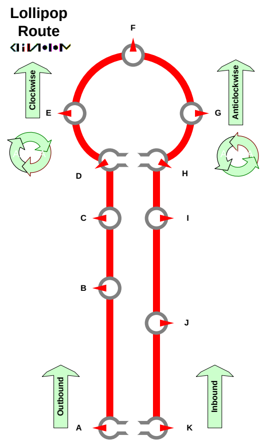


Figure 3-29 – Topology: Lollipop Route

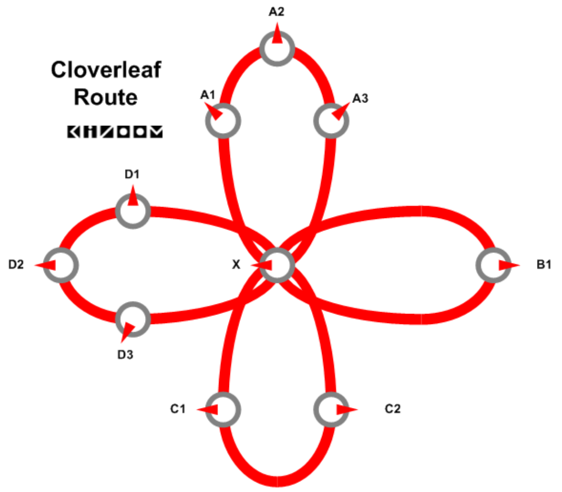


Figure 3-30 – Topology: Cloverleaf Route

3.14.2.2 Services with Complex Temporal Operational Patterns

The *TransXChange* model can be used to represent complex operational times. This is discussed in detail under ‘Modelling Operational Days’ below. All of the following mechanisms are available:

- **Regular day types:** Days of week, Day Combinations, Weeks of month.
- **Special day types:** Bank holidays.
- **Date ranges:** OperatingPeriod, Validity Periods, and Exceptions.
- **Time bands:** Time bands of operation of flexible services.
- **Frequency based:** Interval or minute patterns of operation of frequency based services.
- **Serviced Organisations:** Term-times, holidays or other events of specified organisations.

3.14.3 Modelling Services Efficiently

TransXChange supports an extensive reuse of service and journey description elements so that an efficient encoding of journeys can be achieved. In particular:

- Existing data reference systems can be used; *NaPTAN* stop and stop area definitions, *NPTG* localities.
- Elements describing the network topology and other shared infrastructure entities can be declared once, and then be reused by a simple reference. Notably:
    - Topographical elements: ***StopPoint***, ***StopArea***.
    - Organisational elements: ***ServicedOrganisation, Operator***.
    - Network layer elements: ***Route, RouteSection***.
    - Supply elements: ***JourneyPatternSection,*** and ***JourneyPattern***.
- Link Sequences – the timing link sequences of journey patterns and vehicle journeys – may be reused in several different ways:
    a. A ***JourneyPatternSection*** may be used in many different ***JourneyPattern*** instances.

    b. A given ***JourneyPattern*** may be referenced in many different ***VehicleJourney*** instances, and its values inherited. Only those individual vehicle journey timing links whose properties are different from the corresponding timing links of the underlying journey pattern need be specified.

    c. A ***VehicleJourney*** may specify that particular stops of a referenced ***JourneyPattern*** are omitted, allowing for "express" journeys constrained to a basic journey, and for short working.

    d. A ***VehicleJourney*** may reference another ***VehicleJourney*** to share the timing links of that specific journey.

    e. The ***Frequency*** element of ***VehicleJourney*** may be used to indicate that the same vehicle journey is repeated to the same pattern many times at regular intervals.
- Operational day types and dates may be reused.
    - The ***OperatingProfile*** specified for a ***Service*** can be shared by all the service's vehicle journeys. Individual ***JourneyPattern*** and ***VehicleJourney*** instances need only state their specific differences from the base values.
- Properties of successive links need only be specified when they change:
    - The successive properties of links, such as fare stages and dynamic headings, do not have to be repeated on every link, but only need to be specified when they change from the preceding link.

It remains up to the implementer to decide the degree of reuse that she wishes to achieve. A verbose implementation may, if it wishes, re-declare stops and create separate route, route section, route links, journey pattern, journey pattern section, journey pattern links, operation profile, and special operation profile instances for every single vehicle journey. However it should be note that a verbose implementation (a) wastes space (b) may fail to exchange structural information about the underlying schedule.

3.14.3.1 Overall Reuse of Elements

Figure 3-31 shows some of the ways that elements may be reused at different levels of discourse.

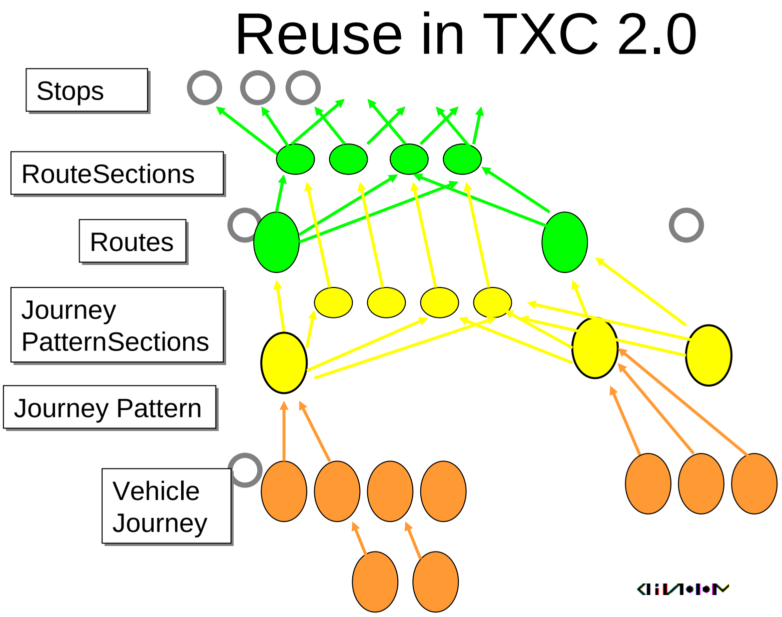


Figure 3-31 – Reuse of Elements

3.14.3.2 Inefficiencies in TransXChange

Although inheritance, default values and reuse can be used to optimise document content, *TransXChange* is not a fully optimised representation, and has a number of data redundancies in its representation. In particular:

- Start and end stop usages are repeated on every successive link in a journey pattern and vehicle journey, including the stop point reference on the journey pattern usage.
- Start and end stop points are repeated on both route links and journey pattern links.

3.14.3.3 Use of Sections

Route sections allow implementers to reuse a sequence of stops and links in more than one route. Journey pattern sections allow the corresponding sequence of timing links to be reused. *Figure 3-32* shows an example of a service comprising three named lines (*Line 54 Line 54A* and *Line 12*). The lines are made up of four routes, containing five sections that group the eleven different links of the network. Two of the sections (*S1 & S2*) are reused in two different routes.

- *Line 54*
  → R1 = S1(L1, L2) + S2(L3 + L4 + L5 + L6)
  → R2 = S1(L1, L2) + S4(L3 + N1 + N2 + L6)
- *Line 54A*
  → R3 = S3(M1) + S2(L3+L4+L5+L6)
- *Line12*
  → R4 = S3(M1) + S5(R1, R2)

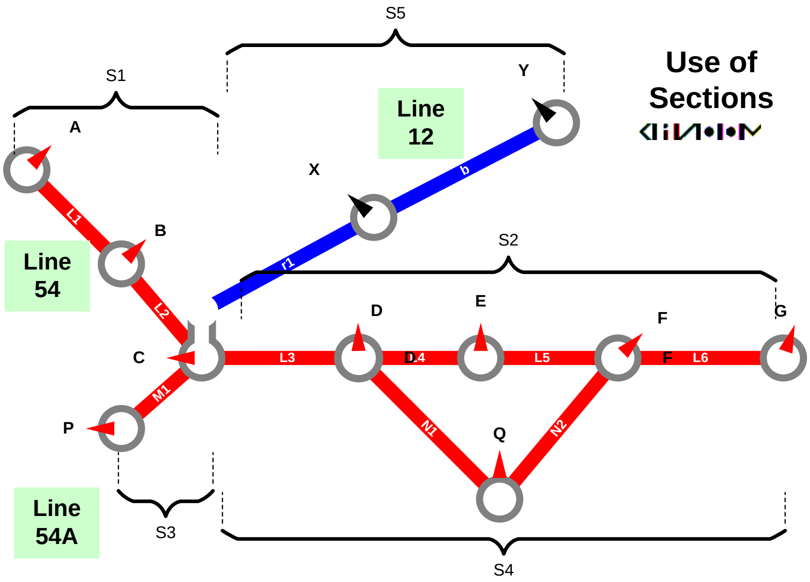


Figure 3-32 – Example of Sections

3.14.4 Presenting Schedules in Timetables

TransXChange is primarily concerned with the representation of schedule data for exchange between different computer systems, and is not intended to address all the additional requirements for presenting schedules as published representations for the public. However it is possible to transform a *TransXChange* schedule into a matrix timetable format automatically, adopting a specific order for showing the stops. Rendering the journeys in a tabular format is valuable because it allows a *TransXChange* document to be validated by human inspection against the originating and published formats.

The *TransXChange Publisher* provides an example of a matrix rendering, which follows a conventional mapping:

- ***VehicleJourney*** instances generally correspond to columns.
    1. Each ***VehicleJourney*** instance can have a ***VehicleJourney*** / ***Note*** associated with it.
    2. Each ***VehicleJourney*** can have an ***OperatingProfile*** to specify operational time information specific to it in a quantitative structure.
    3. If a ***Frequency*** is specified, one or more additional columns may be interpolated to indicate the repeating journeys.
    4. If a ***Frequency*** and the same ***EndTime*** is specified for more than one journey, one or more journey columns may be merged to create a single frequency group. See 3.15.8.3.
    5. ***VehicleJourney*** are ordered as columns across the matrix in the same order as they are declared in the document. Normally they should be sorted into time time order.
- ***JourneyPatternTimingLink / VehicleJourneyStopUsage*** instances generally correspond to each individual row.
- ***VehicleJourneyTimingLink / VehicleJourneyStopUsage*** instances generally correspond to cells for each individual row.
    1. Each ***From*** / ***VehicleJourneyStopUsage*** corresponds to a departure. Normally the departure is shown for all stops of the route except the last.
    2. Each ***To*** / ***VehicleJourneyStopUsage*** corresponds to an arrival. Normally arrivals are only shown for the last stop.
    3. If the arrival and departure time is different at a stop, two separate rows for arrival and departure will be shown.
    4. The stop rows will be ordered down the page in the same order that ***VehicleJourneyStopUsage*** instances appear in the Journey pattern of the Vehicle Journey (unless overridden by a ***SequenceNumber)***.
        - To collate different journeys that follow different journey patterns into a single matrix, the publisher compiles a list of all the stops of all the journey patterns, in order of use. The stops of each vehicle journey are aligned against this list, leaving an empty cell for any stop that is not visited by a particular journey. Thus for example, if two journey patterns A-B-F and A-C-D-F are combined as list, these will be collated as A-B-C-D-F, resulting in column entries A-B-()-()-F for the first and A-()-C-D-F for the second.
        - Within this overall ordering, where there are stops that are specific to particular journey patterns these will be ordered according to the passing time. Thus for example, consider two vehicle journeys using separate patterns A-B-D and A-C-D, which have passing times at stop A(t_1)-B(t_4)-D(t_6) and A(t_2)-C(t_3)-D(t_5) where t_n indicates the relative time. If these are combined as list, these will be ordered A-C-B-D, rather than say A-B-C-D because stop C is visited earlier (t_3) than stop B (t_4).

    - As a further refinement to the overall ordering, the publisher uses the grouping of stops given by the ***JourneyPatternSection*** to sequentially order a series of stops in succession that are a route variants used only by certain journeys, rather than the strict relative time. Thus for example, if two journey patterns A-[B-C-D]-F and A-[P-Q-R]-F are combined as list these will be ordered as A-B-C-D-P-Q-R-F, rather than say as A-B-P-C-Q-D-R-F, regardless of the relative passing times at BCD and PQR. This results in more readable columns entries of A-B-C-D-()-()-()-F and A-()-()-()-P-Q-R-F, rather than say A-B-()-C-()-D-()-F and A-()-P-()-Q-()-R-F.
- A ***SequenceNumber*** attribute can be specified on individual ***JourneyPatternStopUsage*** instances to suggest a preferred sort order of stops for presentation. When listing the stops as rows in a matrix, the explicit number overrides the default traversal sequence that will be otherwise assumed for publication. Note that each vehicle journey is still traversed by a bus in the actual order of its links regardless of any ***SequenceNumber*** instances.

3.14.4.1 Using a Sequence Number

The ***SequenceNumber*** attribute on individual ***JourneyPatternStopUsage*** instances allows you to control the ordering of stops in tabular presentations.

1. Every stop usage of a journey pattern timing link can be allocated a sequence number (i.e. both the departure-from-stop end, and arrival-at-stop end).
2. Either all of the stop usages ('*explicit numbering*'), or none of the stop usages ('*implicit numbering*') of a complete journey pattern should be numbered. (N.B. If some are numbered and some are not, indeterminate effects may occur in applications that make use of the ***SequenceNumber***.)
    - For *implicit* stop numbering, each stop usage is consequentially numbered in order of traversal of the timing links of the route and journey pattern. (Note that journey pattern timing links must in any case visit the same stops in the same order as the route links of any route that the journey pattern references).
    - For *explicit* stop numbering, each stop usage is consequentially numbered in the implementor's preferred presentation order. The actual traversal of the journey timing links for the computation of passing times still follows the sequence of the links of the journey pattern, even if the stops are sequenced in a different order by means of a ***SequenceNumber***.

For example, the *TransXChange Publisher* uses the ***SequenceNumber*** as follows:

1. The publisher builds a matrix by creating a line for each vehicle journey stop usage (i.e. arrival and departure, of each vehicle journey in the service), and sorting them all into stop sequence order.
   - If there are several different underlying journey patterns (i.e. routes) making up the overall service, giving rise to overlapping (or even completely disjoint) sets of stops, the publisher takes the combined set of all stop usages; if the same stop usage appears with the same sequence number in multiple journey patterns, then it is shown as the same stop row.
2. For each column, i.e. vehicle journey, the stop passing times for each stop are computed in the order of traversal of the timing links; times are only shown in cells for the stops that are visited.
3. If the arrival and departure usages for the same stop appear on consecutively lines on the matrix, they can be shown as a single line, showing just the departure time.

3.14.4.2 Example of a Timetable using StopSequence

Figure 3-33 shows a service with two alternate routes (*R1 & R2*) over six stops (labelled alphabetically '*A'* to '*F'*) and which are labelled; line '*1C'*, which runs '*A-B-C-E-F'*, and line '*1D'*, which runs '*A-B-D-E-F'.*

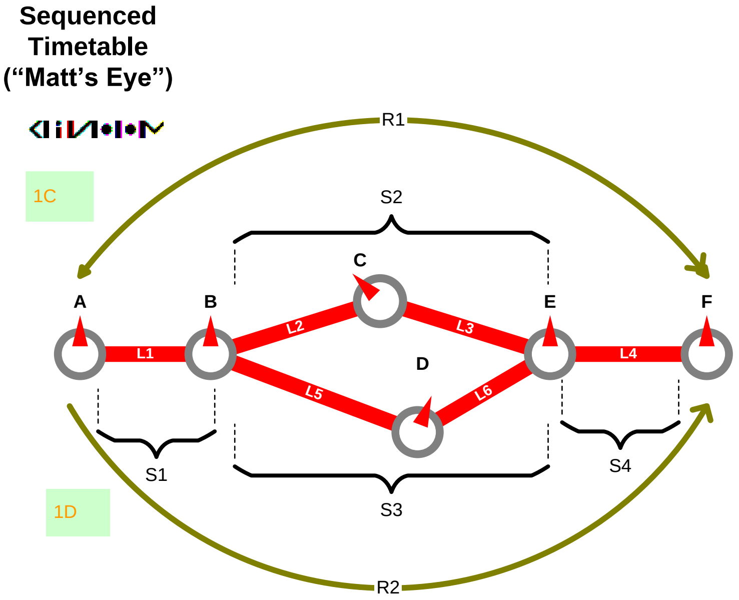


Figure 3-33 – Example: Use of Stop Sequencing

In the published timetable for the service, the preferred presentation might be to show the two journeys aligned on all similar stops – see *Table 3-11.*

	Journey		*SequenceNumber*
	1C	*1D*	*#*
A	10:00	11:00	*1*
B	10:05	11:05	*2*
C	10:10	-------	*3*
D	-------	11:12	*4*
E	10:15	11:17	*5*
F	10:20	11:22	*6*

Table 3-11 – Example: Eye Timetable with Explicit Stop Sequencing

To specify the above presentation we might do the following:

- Break the two routes down into four sections containing route links as follows:
  - • R1 = RS1(RL1) + RS2(RL2, RL3) + RS4(RL4)
  - • R2 = RS1(RL1) + RS3(RL5, RL6) + RS4(RL4)
- Define a journey pattern, JP1, over route R1, specifying a preferred stop sequence *n* for each end of each timing link:
  - • JP1 = → R1

    [JS1(→RL1: JPTL1[*5mn*, from:1, to: 2])
    + JS2(→RL2: JPTL2[*5mn*, from:2, to: 3]. →RL3: JPTL3[*5mn*, from:3, to: 5])
    + JS4(→RL5: JPTL4[*5mn*, from:5, to: 6])]
- Define a journey pattern, JP2, over route R2: also specifying a preferred stop sequence:
  - JP2 = → R2
    [JS1(→RL1: JPTL1[*5mn*, from:1, to: 2])
    + JS3(→RL5: JPTL5[*7mn*, from:2, to: 4], →RL6: JPTL6[*5mn*, from:4, to: 5])
    + JS4(→RL4: JPTL4[*5mn*, from:5, to: 6])]

As a comparison, Figure 3-34 shows the default ordering that would be used by the *TransXChange Publisher* if no sequence guidance was given. Note this is a difference of presentation, not representation – in the underlying *TransXChange* document, each individual vehicle journey is still correctly ordered as to its sequence of visiting the stops by virtue of its journey pattern. If wait times had been specified, then arrival and departure would be distinct.

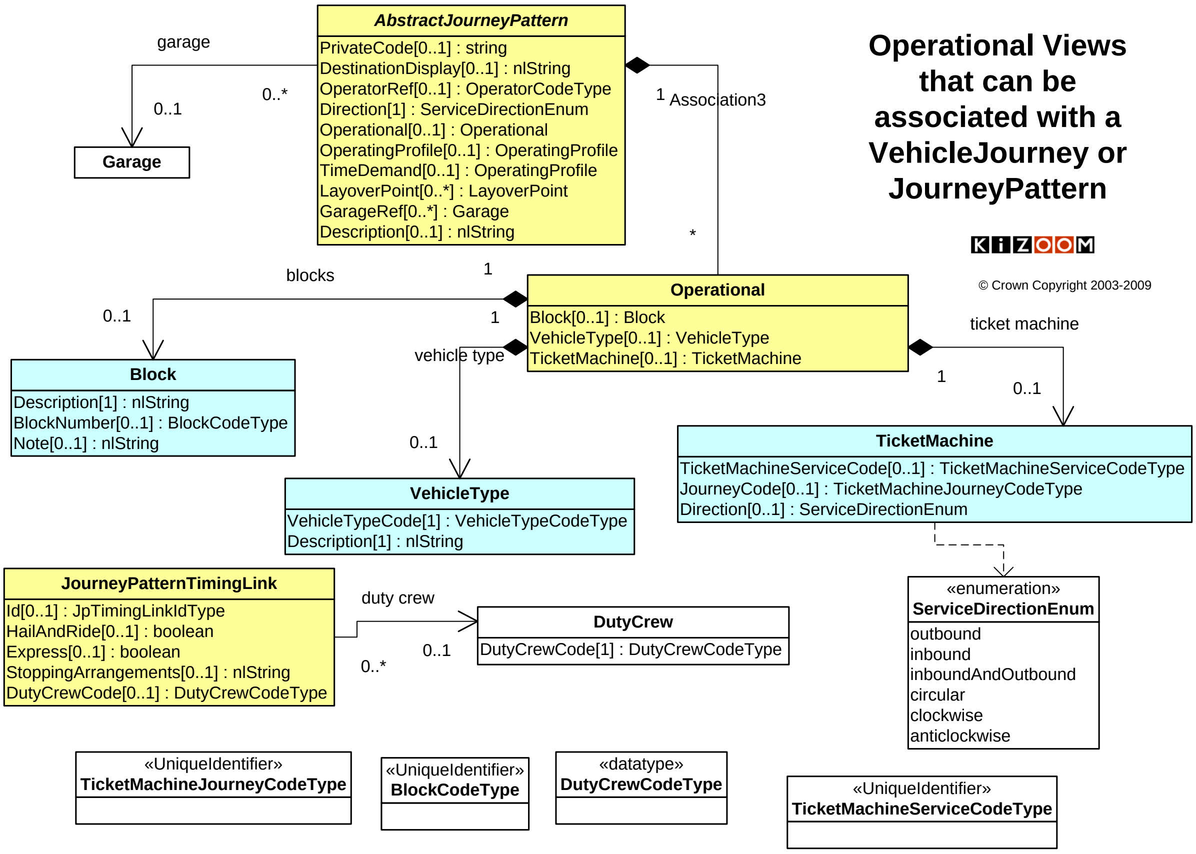
Stop	**1C**	**1D**
A	*Dep 10:00*	*Dep 11:00*
B	*Dep 10:05*	*Dep 11:05*
C	*Dep 10:10*	-
E	*Arr 10:15*	-
B	-	*Dep 11:05*
D	-	*Dep 11:12*
E	-	*Arr 11:17*
E	*Dep 10:15*	*Dep 11:17*
F	*Arr 10:20*	*Arr 11:20*

Table 3-12 – Example: Eye Timetable with Implicit Stop Sequencing

3.14.5 Associating operational data with a timetable

TransXChange provides several means of associating different types of operational data with the elements of a timetable (See Figure 3-34). For example,

- ***JourneyPatterns*** & ***VehicleJourneys*** may be associated with a Operational element that specifies a Block, ***VehicleType*** or ***TicketMachine*** for a journey.
- A ***TimingLink*** may specify a ***DutyCrew*** for a link.


Operational Views that can be associated with a VehicleJourney or JourneyPattern
KIZOOM
AbstractJourneyPattern
PrivateCode[0..1] : string
DestinationDisplay[0..1] : nlString
OperatorRef[0..1] : OperatorCodeType
Direction[1] : ServiceDirectionEnum
Operational[0..1] : Operational
OperatingProfile[0..1] : OperatingProfile
TimeDemand[0..1] : OperatingProfile
LayoverPoint[0..*] : LayoverPoint
GarageRef[0..*] : Garage
Description[0..1] : nlString
garage
0..*
0..1
Garage
1
Association3
*
blocks
1
0..1
Operational
1
Block[0..1] : Block
VehicleType[0..1] : VehicleType
TicketMachine[0..1] : TicketMachine
vehicle type
ticket machine
1
0..1
Block
Description[1] : nlString
BlockNumber[0..1] : BlockCodeType
Note[0..1] : nlString
0..1
VehicleType
VehicleTypeCode[1] : VehicleTypeCodeType
Description[1] : nlString
TicketMachine
TicketMachineServiceCode[0..1] : TicketMachineServiceCodeType
JourneyCode[0..1] : TicketMachineJourneyCodeType
Direction[0..1] : ServiceDirectionEnum
JourneyPatternTimingLink
Id[0..1] : JpTimingLinkIdType
HailAndRide[0..1] : boolean
Express[0..1] : boolean
StoppingArrangements[0..1] : nlString
DutyCrewCode[0..1] : DutyCrewCodeType
duty crew
DutyCrew
0..1
DutyCrewCode[1] : DutyCrewCodeType
0..*
«enumeration»
ServiceDirectionEnum
outbound
inbound
inboundAndOutbound
circular
clockwise
anticlockwise
«UniqueIdentifier»
TicketMachineJourneyCodeType
«UniqueIdentifier»
BlockCodeType
«datatype»
DutyCrewCodeType
«UniqueIdentifier»
TicketMachineServiceCodeType

© Crown Copyright 2003-2009

Figure 3-34 – UML Diagram of Operational data elements

3.15 Modelling Operational Days

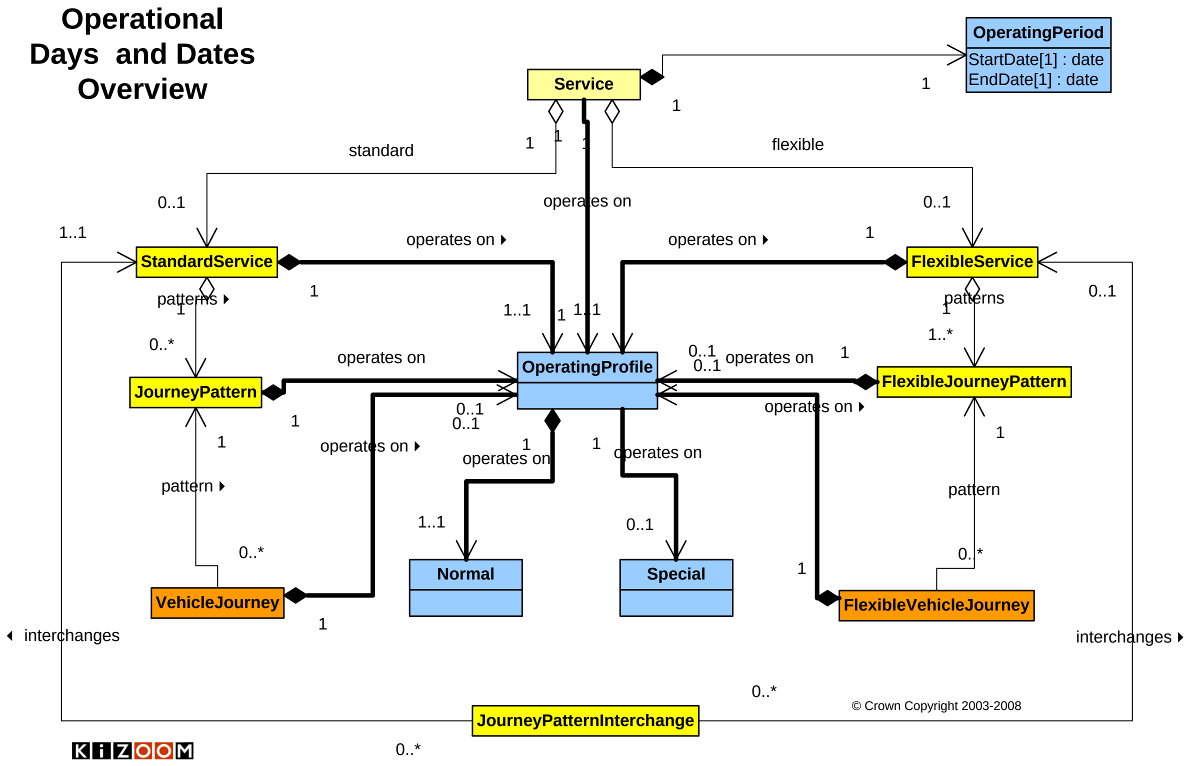
TransXChange has rich (and complex!) capabilities for specifying the operational days and times of a bus service for both regular running, and for exceptional days. We introduce these capabilities here. For further details, see the descriptions of individual schema elements. For an overall summary of how to combine date conditions, see also *Section 13* ‘Integrity Rules’.

3.15.1 Specifying When the Service Operates – Summary

The ***OperatingProfile*** specifies when a bus service runs, including both the types of days (e.g. Monday to Friday) on which the service normally runs; and what happens on special days such as Bank Holidays, and can also describe any exceptional periods of operation.

- An overall ***OperatingPeriod*** can also be specified at the service level. This can be open ended.
- Default ***OperatingProfile*** values can be specified at the ***Service*** level, and be overridden at both the ***JourneyPattern*** level and on individual ***VehicleJourney*** instances.
- Validity periods can also be specified for the operation of ***JourneyPatternInterchange*** instances, constraining the availability of interchanges between specified ***VehicleJourney*** instances.

Figure 3-35, in UML class diagram notation, gives a high-level view of the main elements and relationships concerned with operational days.



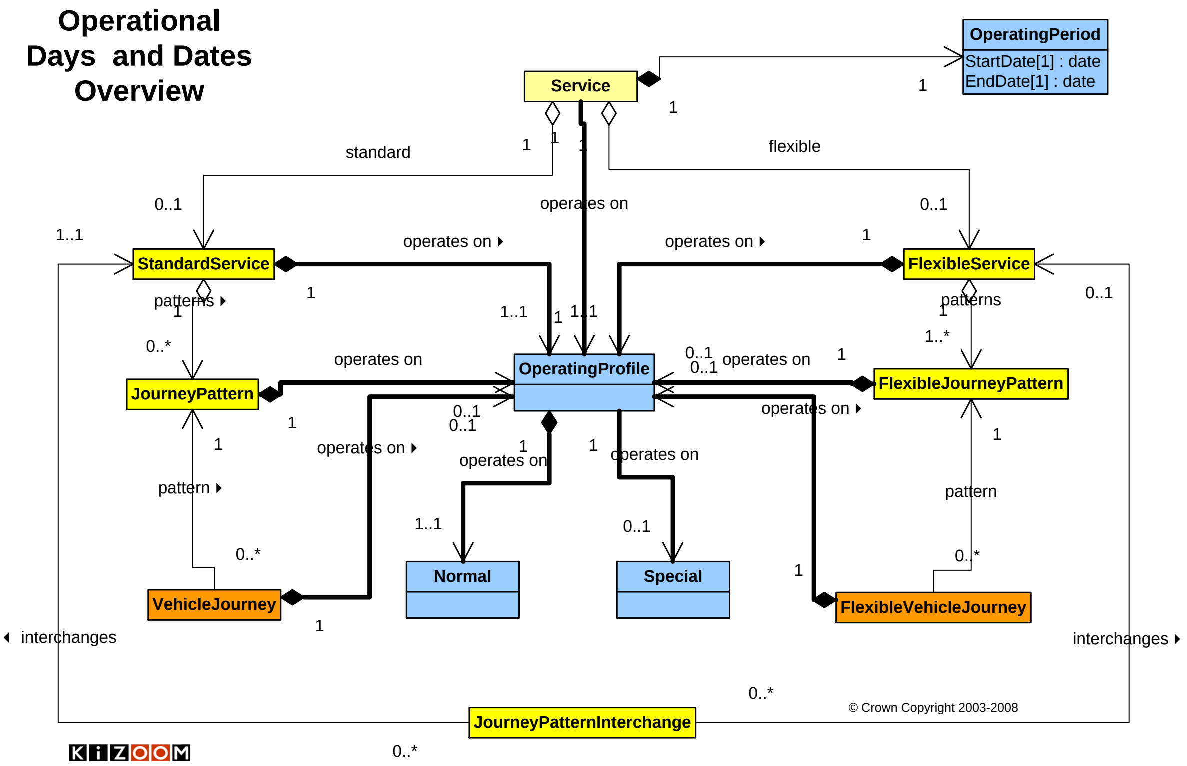


Figure 3-35 – UML Diagram Overview of Operational Times

3.15.2 Regular Operation – OperatingProfile

The ***OperatingProfile / Normal*** group specifies the normal operating day types of a service. It can be made up of three elements, as shown in the UML structure diagram in *Figure 3-36*:

- The types of day (***RegularDayType***) on which the service runs; for example, '*Monday to Friday', 'Sunday',* or *'Wednesday and Saturday.*'
- The weeks of the month on which the service is operated for the given day types; for example, 'first and third weeks of the month'. The ***PeriodicDayType*** further qualifies the ***RegularDayType***, (for example, a market service that might run '*Wednesdays and Saturdays, first and third weeks of the month'*).
- The holiday or working day types of the serviced organisation for which the service runs (for example, '*term times for City of London School for Girls'*) – see ***ServicedOrganisation*** in Section 3.15.4 below. The ***ServicedOrganisationDayType*** further qualifies the periodic and regular day type. For example, '*Wednesdays, during term times for City of London School for Girls".*

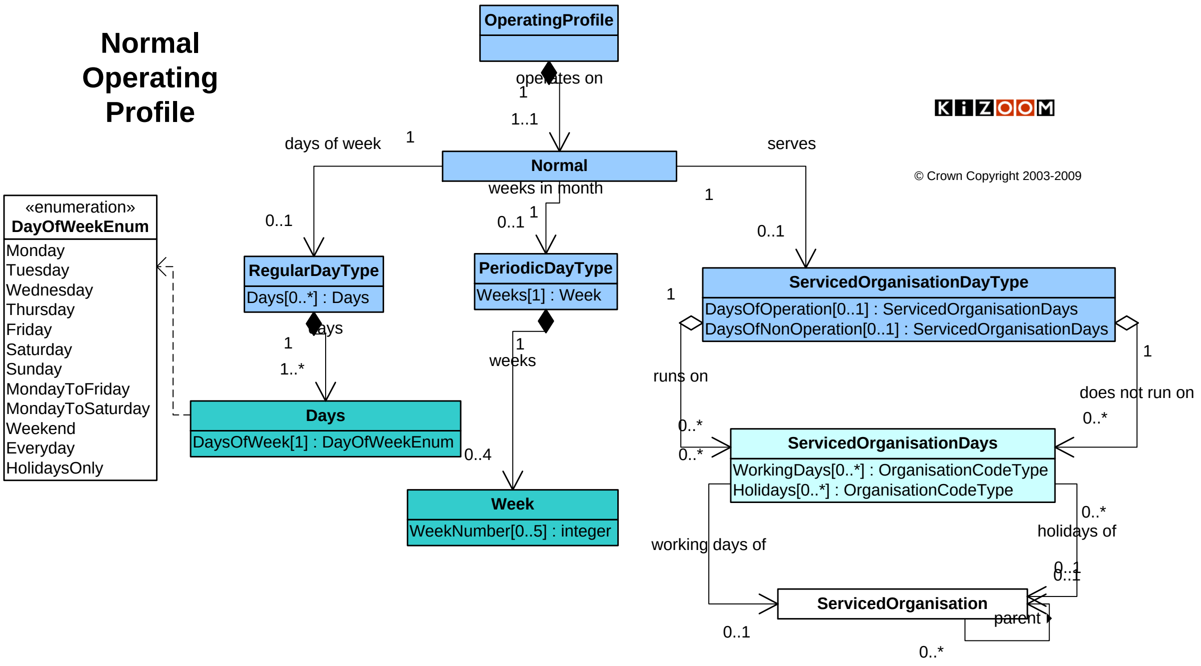


Figure 3-36 – UML Diagram of Normal Operation Profile

3.15.3 Exceptional Operation – OperatingProfile

The ***OperatingProfile / Special*** group specifies the exceptional operating days of a service. It can be made up of two distinct elements, as shown in the UML structure diagram in *Figure 3-37*:

- How the service operates on a bank holiday (***BankHolidaysOperation***). A number of different bank holiday day types are supported for both individual days and groups of days. For example '*Does not run Christmas, New Year's Day, Good Friday', 'Runs Bank Holiday Mondays'.* Day types include moveable feasts, such as *Easter Day*, whose day may vary from year to year. The holidays on which the service does (inclusion) or does not (exclusion) run are specified separately.
- Any special operating dates on which the service does (inclusion) or does not (exclusion) run (***SpecialDaysOperation***). Special days are always absolute

calendar dates or calendar date ranges. For example ‘*does not run 11/11/2005’.* Special days override any Bank Holiday day types.

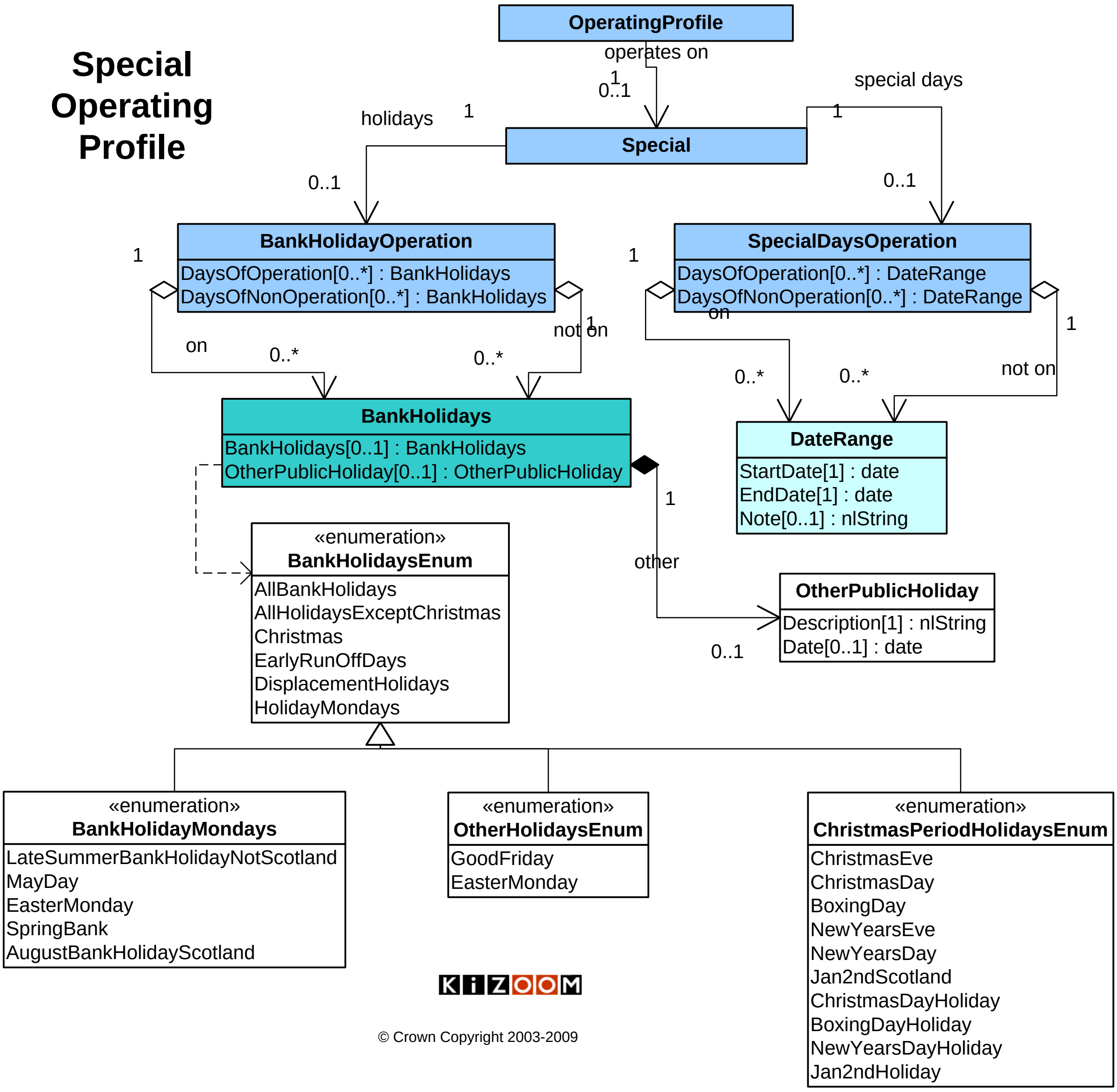


Figure 3-37 – UML Diagram of Special Operation Profile

A statement that a service does not operate on specific days should not be interpreted as implying that it operates on all other days. Similarly a statement that a service runs on a particular day does not necessarily imply that it does not run on all other days.

Note that the exclusion and inclusion of special days of operation have different meanings (see also ‘General Principles for Using Operational Days’ below):

- The Special Operation profile days of **non-operation** i.e. exclusion should be interpreted as further **constraining** the days of week and month of the Normal Operating Profile. For example, if the Normal Profile specifies that a service runs ‘Monday to Friday’, and the Special Operation Profile specifies that the Service does not run on New Year’s Day, it will not run on New Year’s Day, whatever day of the week New Year’s Day occurs.
- The Special Operation profile days of explicit **operation** (i.e. inclusion) should be interpreted as being **additive** to the days of week and month of the Normal Operating

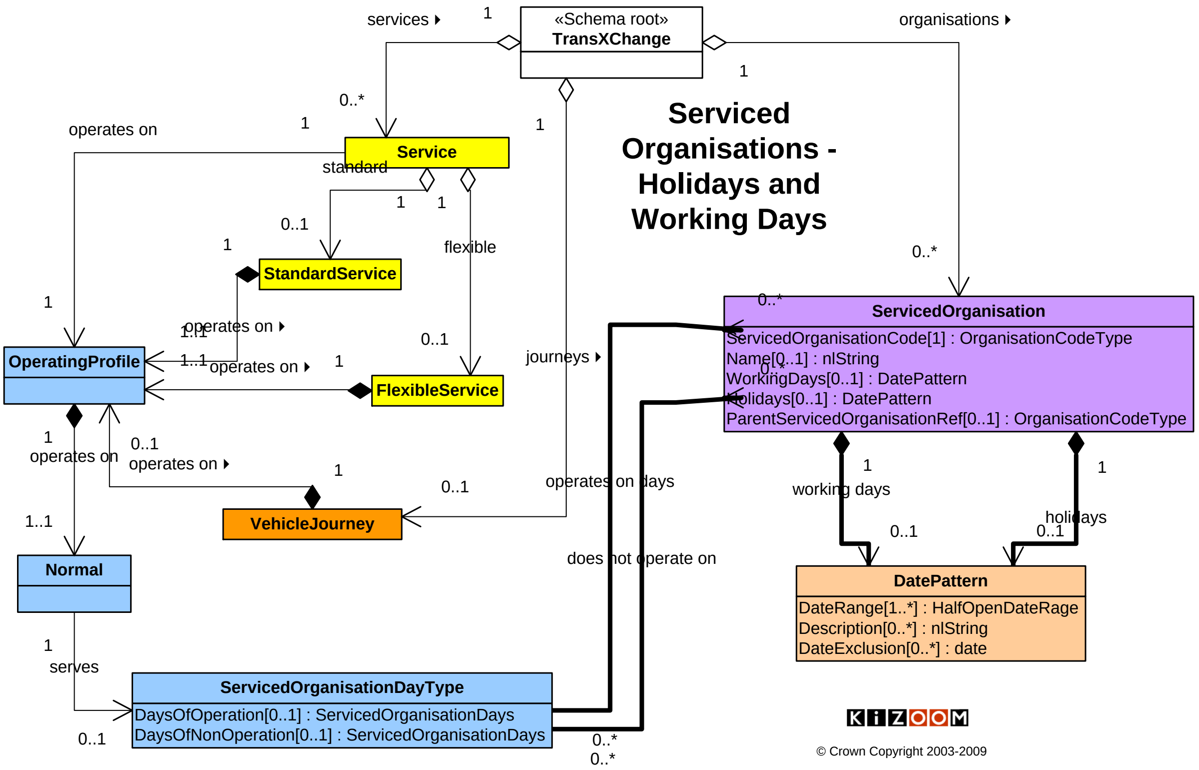
Profile. For example, if the Normal Operation Profile specifies that a service runs '*Sunday'*, and the Special Operation Profile specifies that the Service *does* run on New Year's Day, then the service also runs to that timetable on New Year's Day, regardless of the day of week New Year's Day falls.

Thus a typical usage is to have a lower frequency Service timetable that is used for Sundays and Bank Holidays, and a regular timetable that is used for weekdays, except when the weekday is a Bank holiday.

3.15.4 Services that Run for Specific ServicedOrganisation Working Days

Operational day types can be specified in terms of the working days or holidays of specified organisations, for example schools. See *Figure 3-38* in UML notation. A hierarchical parent relationship can be used to specify that working days are derived from those of another organisation, for example a Local Education Authority (LEAs), with specific variations.

- LEAs and their Schools are modelled in the schema by a ***ServicedOrganisation*** element. Each ***ServicedOrganisation*** may have a parent relationship (which should be acyclic) to another ***ServicedOrganisation***.
- Patterns of ***WorkingDays*** and ***Holidays*** may be specified for service organisations.
- Working days and holidays may be inherited from a parent organisation.
- Services and vehicle journeys may be associated with one or more organisations on the ***ServicedOrganisationDayType*** as part of the normal ***OperatingProfile***.

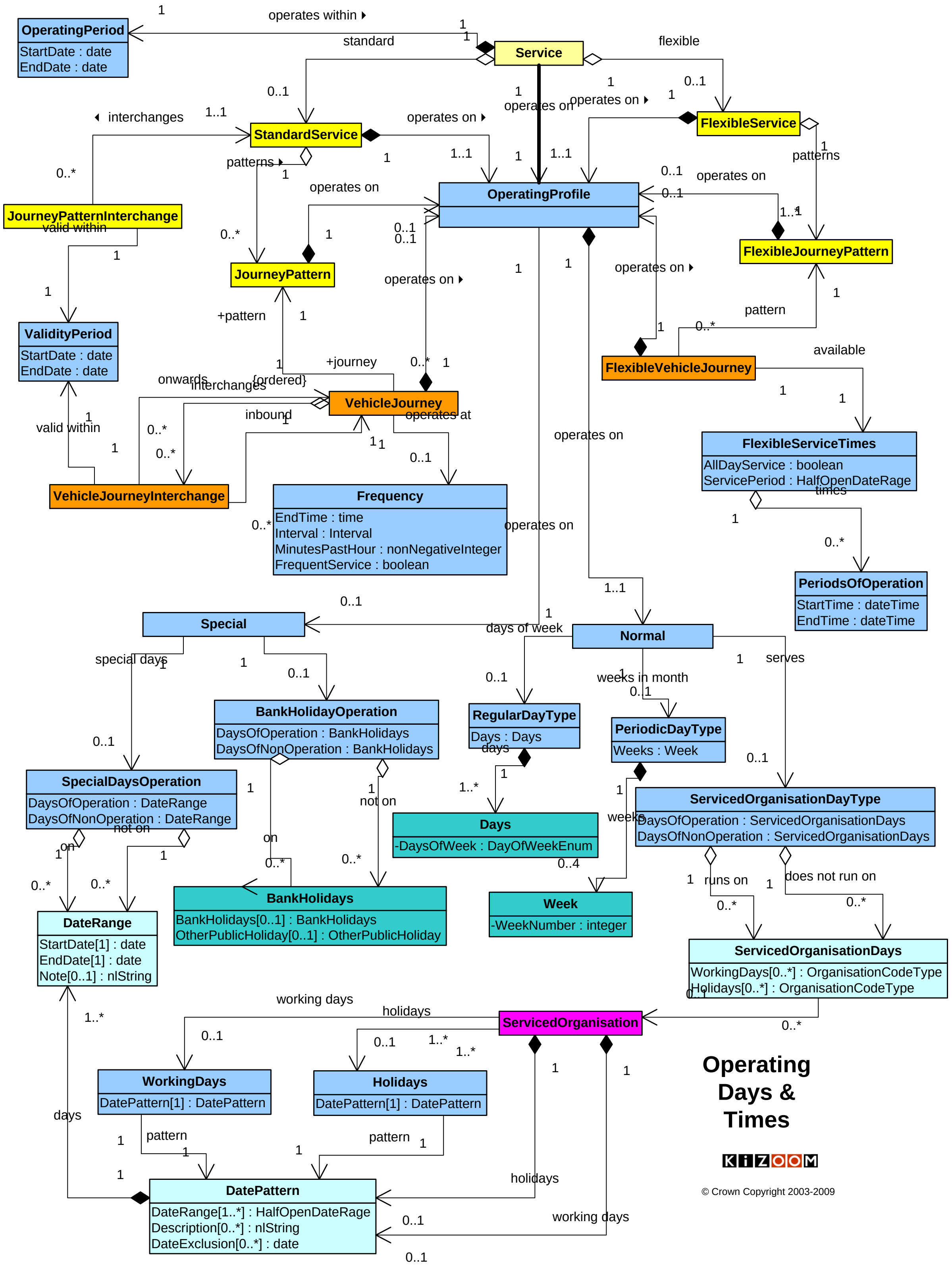

services ▸
1
«Schema root»
TransXChange
organisations ▸
1
Serviced Organisations - Holidays and Working Days
0..*
operates on
1
Service
standard
1
1
1
0..1
1
flexible
StandardService
0..*
1
0..*
1..1
operates on ▸
0..1
OperatingProfile
1..1
operates on ▸
1
journeys ▸
FlexibleService
ServicedOrganisation
ServicedOrganisationCode[1] : OrganisationCodeType
Name[0..1] : nlString
WorkingDays[0..1] : DatePattern
Holidays[0..1] : DatePattern
ParentServicedOrganisationRef[0..1] : OrganisationCodeType
0..*
1
operates on
0..1
operates on ▸
1
0..1
operates on days
1
working days
1
VehicleJourney
1..1
0..1
holidays
0..1
does not operate on
Normal
DatePattern
DateRange[1..*] : HalfOpenDateRage
Description[0..*] : nlString
DateExclusion[0..*] : date
1
serves
ServicedOrganisationDayType
DaysOfOperation[0..1] : ServicedOrganisationDays
DaysOfNonOperation[0..1] : ServicedOrganisationDays
0..1
0..*
0..*
KIZOOM

© Crown Copyright 2003-2009

Figure 3-38 – UML Diagram of Serviced Organisation Days

3.15.5 OperatingProfile Elements

Figure 3-39 summarises, as a UML diagram, the elements that make up the ***OperatingProfile***, as well as other significant elements governing operational times such as ***OperatingPeriod***.



Operating Days & Times

KIZOOM

© Crown Copyright 2003-2009

Figure 3-39 – UML Diagram of Operational Time Elements

3.15.6 General Principles for Using Operational Days

The *TransXChange* model has capabilities to specify operational days at a number of different levels of discourse (Service, Journey Pattern, Vehicle Journey, Journey Interchange); and to state operational days in both relative and absolute terms; that is,

(i) As general *day types*, such as 'Monday to Friday', or 'Christmas Day' (using the ***OperatingProfile / Normal*** elements).

(ii) As *absolute* calendar dates, such as '5th - 7th August 2005' (using the ***OperatingProfile / Special*** elements).

The different mechanisms can be combined to provide an overall set of operational conditions for a given vehicle journey that is to run on a given day of operation.

When interpreting a schedule, a number of simplifying rules are followed for combining the various element types to avoid ambiguity. The following general principles are followed for the use of operational days:

1. **Elements specified for a given profile property at a lower level of discourse completely replace the equivalent element at a higher level**. For example, if a Journey level operating profile specifies days of operation as '*Monday to Friday'* and a vehicle journey specifies '*Saturday'*, then the vehicle journey runs only on '*Saturday'*, not '*Monday to Saturda*y'. Similar considerations apply to Serviced Organisation operating days for parent and child Service Organisation levels.
2. **Lower level of discourse overrides higher level for operational days.** In particular, any operational days specified for a specific vehicle journey take precedence over those specified over the journey pattern; and any for the journey pattern over those specified for the whole service. For example, a vehicle journey may state more restricted or more extensive operation days than the overall service. *Table 3-13* shows the relative precedence of levels of discourse. Similarly Serviced Organisation properties override those of any parent organisation.

Operational days Precedence (1 high)	Level
1	***VehicleJourneyInterchange***.
2	***VehicleJourney.***
3	***JourneyPatternInterchange.***
4	***JourneyPattern***.
5	***Service***.

Table 3-13 – Precedence of Entity Levels

3. **Exceptional operation overrides regular operation**. Thus ***OperatingProfile* Special** dates override any dates indicated by ***OperatingProfile* Normal** day types.
4. **Exclusion constrains, inclusion adds.** Special days of non-operating further restrict the normal profile; special days of operation are additional to the profile.
5. **Non-operation overrides operation**. If *conflicting* overlapping dates for operation and non-operation days are specified, the non-operation is assumed to be correct at any given level of discourse. This applies only within each level of discourse – operational days at a lower level override non-operational days at a higher level.
6. **More specific day type overrides less specific day type**. At any given level of discourse, more specific normal ***OperatingProfile*** day type values qualify the less specific values – as shown in *Table 3-14*.

Precedence (1 high)	Days
1	***ServicedOrganisationDayType*** days of non-operation.
2	***ServicedOrganisationDayType*** days of operation.
3	***PeriodicDayType*** qualifier.
4	***RegularDayType*** days.

Table 3-14 – Precedence of Normal Operation Day Types

3.15.7 Frequent Services

A *Frequent service* is a service that meets the regulatory requirements for being classified as a frequent service, i.e. that runs to a frequency of every ten minutes or less in accordance with the Statutory Requirement, and that is to be formally registered as constituting a *Frequent Service,* as indicated by a ***FrequentService*** flag. Note that in addition, a minimum and maximum time gap between services operating as a frequency service can also be specified using the ***MinimumFrequency*** and ***MaximumFrequency*** elements.

Journeys which comprise a frequent service do not have to run at an absolutely regular frequency interval - they could be quite variable, such as every 2 - 7 minutes, as long as no service interval exceeds 10 minutes between consecutive journeys. The service should be describe as running to its lowest available frequency e.g. '*Frequent service at least every 7 mins.'*).

3.15.8 Frequency Based Services

Independently of whether the service is legally a *Frequent Service*, the TXC schema supports a *Frequency Based* Service definition*:* that is, a service that runs to a regular frequency, for example '*every 5 minutes' or 'every 15 minutes*', rather than to a specific timetable (and which may or may not be a statutory *Frequent Service* – in which case it would be phrased *'Frequent service at least every 5 mins..'*).
The frequency pattern of a ***VehicleJourney*** is described by a ***Frequency*** element which holds elements giving the frequency of the service, and an end time. Frequencies may be specified either as an ***Interval*** of minutes (see *Table 3-16),* or as a collection of ***MinutesPastTheHour*** instances (see *Table 3-17)*.

The TransXChange schema allows the departure times for vehicle journeys occurring at regular intervals to be coded efficiently as a single vehicle journey, with a frequency to be repeated and an end-time (i.e. the last departure time that follows the standard pattern). Such journeys may or may not be part of a *Frequent Service*. Using the mechanism, just one vehicle journey is needed in the document rather than, say, many journeys that are identical but for the departure time. The interval is arbitrary – i.e. may be longer than that required to be a *Frequent Service* in the regulatory sense. The TransXChange Publisher will then generate the necessary

3.15.8.1 Frequency Described by Interval

Table 3-15 shows a frequency based timetable described using a single journey and Frequency interval. Only the initial journey of a period of frequency based service need be explicitly given, so the entire timetable can be described by a single vehicle journey, as per column #1, together with a ***ScheduledFrequency*** (*15 minutes*) and an ***EndTime*** (*12:04*).

DepartureTime	*9:02*
ScheduledFrequency	*15*
EndTime	*12:02*
	#J1
Grub Street	9:02
Tin Pan Alley	9:12
Sinister Street	9:32

Table 3-15 – Frequency Service Timetable: Representation

Table 3-16 shows this as published - the Publisher generates the additional columns.

	J1	J1

	#1	#2
Grub Street	9:02	Then every 15 minutes until 12:02
Tin Pan Alley	9:12	
Sinister Street	9:32	

Table 3-16 – Example Frequent Service Timetable: Minutes

3.15.8.2 Departure Described by Minutes Past Hour

Table 3-17 shows an example of a service described using minutes past the hour. This can be used to describe services that don't run at regular intervals columns #1, #2 and #3 are all described by a single vehicle journey with a start and end time, and a frequency stated as two different minutes past the hour. Column #4 is a new journey.

Start time	*9:02*			
Minutes {Past Hour	--	*12*	*30*	**--**
EndTime				12:02
	#1	**#2**	**#3**	**#4**
		Then at the following minutes past the hour		**until**
Grub Street	9:02	12	30	12:02
Tin Pan Alley	9:12	22	40	12:12
Sinister Street	9:32	42	00	12:32

Table 3-17 – Example Frequent Service Timetable: Interval

Frequency Described on Multiple Individual Journeys

For some purposes it is useful to supply information about every single journey making up a *Frequent service*, for example so as to be able to specify operational Block and Run information on journeys for AVL systems. Within the period of frequent operation these multiple, individually timed journeys can still be published as a single Frequency Group, that is a column of start times and a column giving the frequency, rather than separate columns fro each journey. The enhanced TransXChange publisher will perform this merging of separate journeys as follows:

- If successive vehicle journeys are (a) flagged as *Frequency Based* (b) have the same ***EndTime*** as the previous journey, then they will be collapsed into a single Frequency column.
- The indicated frequency values should normally also be the same for all journeys (***ScheduledFrequency, MinimumFrequency***, ***MaximumFrequency,).*** If they differ the values from the first journey will be used and a diagnostic will beaded to the validation report.
- *If any frequent services are provided as individual journeys for a frequent service in a document then all the individual journeys should be provided*.
- Note that the individual vehicle journeys themselves do not have to be at exactly regular intervals.
- The merging of journeys by the publisher can be suppressed using the ***mergeFrequencyJourneys*** option. (this is useful for those that wish to see the underlying data).

Thus one might have many journeys, , the journey intervals are all slightly different as indicated by different start times, but less than the 10 minutes but rather than construing them as separate journeys in Table 3-18 below.

Departure time	*9:02*	9:10	9:16	9:21		12:02
ScheduledFrequency	*7*	*7*	*7*	*7*		*7*
MinimumFrequency	*6*	*6*	*6*	*6*		*6*

MaximumFrequency	*8*	*8*	*8*	*8*		*8*
EndTime	12:02	12:02	12:02	12:02		12:02
	J1	**J2**	**J3**	**J4**		**J(n)**
Grub Street	9:02	9:10	9:16	9:21	Etc	12:02
Tin Pan Alley	9:12	9:20	9:26	9:31		12:12
Sinister Street	9:32	9:40	9:36	9:51		12:32

Table 3-18 – Multi-journey Representation of Frequency Based journeys

The Publisher would present the journeys more concisely as in Table 3-19. (The actual text in column #2 will vary as per Table 3-22.

	j1	j2 to j(n-1)	j(n)
	#1	**#2**	**#3**
Grub Street	9:02	Frequent service at an interval of no more than **7** mins	12:02
Tin Pan Alley	9:12		12:12
Sinister Street	9:32		12:32

Table 3-19 – Merged presentation of separate Frequency journeys with identical frequencies

3.15.8.3 Multi-journey to single group, Multiple frequencies

If the frequency changes between journeys, as in Table 3-20

Departure time	*9:02*	9:17	9:32	9:47		11:02	11:20		16:00
ScheduledFrequency	*15*	*15*	*15*	*15*	*15*	*15*	*20*	20	*20*
EndTime	*1102*	*1102*	*1102*	*1102*		*11:02*	*1600*		*16:00*
	J1	**J2**	**J3**	**J4**		**J(n)**	**J(m)**		**J(p)**
Grub Street	9:02	9:17	9:32	9:47	Etc	11:02	11:20	Etc	16:00
Tin Pan Alley	9:12	9:27	9:42	9:57		11:12	11:30		16:10
Sinister Street	9:32	9:47	10:02	10:17		11:32	11:50		16:30

Table 3-20 – Multi-journey Representation of Two Frequencies

The Publisher can add additional columns to describe the change in frequency as in Table 3-21. The additional column would be triggered by separate ***EndTime*** values (11:02, then 16:00), not by the separate ScheduledFrequency value, If the end time is the same, only a single column will be shown with the first scheduled frequency.

	j1	j2 to j(n-1)	j(n)	j(m)	j(m+1) to j(p-1)	j(p)
	#1	**#2**	**#3**	**#4**	**#5**	**#6**
Grub Street	9:02	Then every 15 minutes	11:02	11:20	Then every 20 minutes	16:00
Tin Pan Alley	9:12		11:12	12:32		16:10
Sinister Street	9:32		11:32	13:42		16:40

Table 3-21 – Merged presentation of separate Journeys with different frequencies

3.15.8.4 Text Descriptions for Frequency service

The text caption used in a column o describe the frequency is generated from the values of the ***ScheduledFrequency MinimumFrequency***, ***MaximumFrequency*** associated with the journey, as per Table 3-22. For registrations the less informative Statutory definition is used For non registration publication

Case	**Frequent Service**	**Scheduled-Frequency Interval** (mins)	**Minimum-Frequency Interval** (mins)	**Maximum Frequency Interval** (mins)	**Result Phrase to show in matrix column for NON-REGISTRATION details**	**Result Phrase to show in matrix column for REGISTRATIONS**

1	true	x	-	-	*then about every [**x**] minutes until*	*Frequent service at least every10 mins until*
2	true	x	m	-	*then at [**m-x**] minutes intervals until*	*Frequent service at least every10 mins until*
3	true	x	-	n	*then at intervals of no more than [**n**] mins until*	*Frequent service at least every 10 mins until*
4	true	x	m	n	*then at[**m-n**] minutes intervals until*	*Frequent service at least every 10 mins until*
5	false	x	-	-	*then about every [**x**] minutes until*	*Then About every[**x**] mins until*
(6)	false	x	m	-	*then about every [m-x] minutes until*	*(Then About every[x] mins until)*
(7)	false	x	-	n	*then at intervals of no more than [n] mins until*	*(Then About every[x] mins until)*
(8)	false	x	m	n	*then at[m-n] minutes intervals until*	*(Then About every[x] mins until)*

Table 3-22 – Frequency service Text Descriptions

3.15.9 Service Operational Days

Using the principles given above, we can summarise the use of the operational day elements shown in *Figure 3-39* to specify the operational days of a ***Service*** as follows:

1. Each ***Service*** has an ***OperatingPeriod*** defining its overall start and end dates. All operational dates must fall within this period. The end date may be open.

2. Each ***Service*** can have a *default* ***OperatingProfile*** describing its operation: the ***Service*** / ***OperatingProfile*** normal elements are used to provide default values for all vehicle journeys of the service. Regular days can be specified in any or all of three ways (which can be combined together):
   a. ***RegularDayType***: Any combination of days of the week on which the service runs. Defaults to ***MondayToSunday*** if not specified.
   b. ***PeriodicDayType***: Additional qualifier of specific weeks of month on which the regular service runs.
   c. ***ServicedOrganisationDayType***: Dates defined by the working days or holidays of a named organisation, such as a school or Local Education Authority. ServicedOrganisations can also be used to represent other types of organisation such as *Works, Football Stadia.*

   Special days can be specified in two ways (which can be combined together):
   d. ***BankHolidayOperation:*** Specific named ***BankHoliday*** day types (for example, ***ChristmasDay***; see ***BankHoliday*** element *Figure 6-98*), or instances of one-off holidays (such as, say, a Silver Jubilee) described by an ***OtherPublicHoliday*** instance, are assigned to one of two categories:
      i. *Days of operation*. Bank holiday days for which the service operates. If the specified days of *operation* overlap with days of non-operation, the days of non-operation take precedence.
      ii. *Days of non-operation*. Bank holiday days for which the service does not operate. If the specified days of non-operation overlap with days of operation, the days of non-operation take precedence over days of operation.
   e. ***SpecialDaysOfOperation:*** Specific ***DateRange*** elements, assigned to one of two categories:
      i. *Days of operation*. If the specified days of operation overlap with days of non-operation, the days of non-operation take precedence.
      ii. *Days of non-operation*. If the specified days of non-operation overlap with days of operation, the days of non-operation take precedence over days of operation.

3. Each ***JourneyPattern*** can also have a *specific* ***OperatingProfile,*** describing its individual operational days. The profile is made up of the same elements as the Service profile. Any values override the service level values.

4. Each ***VehicleJourney*** can have a *specific* ***OperatingProfile,*** describing its individual operational days. The profile is made up of the same elements as the Service profile. Any values override any service and journey pattern level values.

5. Interchange ***ValidityPeriod:*** As a further complication, a ***ValidityPeriod*** may be specified for individual interchanges at both the ***JourneyPatternInterchange*** and the ***VehicleJourneyInterchange*** level.
    a. Use of the Interchange is only valid during the specified validity period. The connection will not be available to the inbound vehicle journey except during the validity period.
    b. Any ***ValidityPeriod*** specified at the ***VehicleJourneyInterchange*** level overrides any ***ValidityPeriod*** specified at the ***JourneyPatternInterchange*** level.

Table 14-5 in Section 14.3; '*Precedence Rules for Dates'*, summarises the conditions for specifying dates.

3.15.10 Structure Example of Schedule with Operational Day Exceptions

For an Example of a service using complex dates and times see the *Interchange Example*.

3.16 Summary of TransXChange Entities and Identifiers

Table 3-23 summarises the significant entities of the *TransXChange* model. It also shows the identifiers used for each element and their scope (which in all cases must be unique within a document). The element identifiers fall into three scope groups:

- *External Codes forming part of well defined national data systems* (‘A’). For example the ***AtcoCode***, as defined in the *NaPTAN* data set. External codes are modelled as elements. These identifiers will always remain the same on repeated reissues of a given schedule as a *TransXChange* document.
- *External Codes forming part of arbitrary data systems.* (‘B’). External codes are modelled as XML elements, and their names generally end in either ‘***Code’*** or ‘***Number’.*** These identifiers will normally remain the same on repeated reissues of a given schedule as a *TransXChange* document.
- *Internal Identifiers* used to identify objects locally within a document (‘C’). Internal identifiers are modelled as an ***id*** attribute on the entity element. All id attributes are if type ***IdType***. It is up to the application to decide whether internal identifiers should persist between different versions of a document. Typically there is no guarantee that these will remain the same on repeated reissues of a given schedule as a *TransXChange* document, though implementors are free to make them so if they wish.

Entity	Identifier				
	Type	Req-uired	Name	Has Private Code	Scope
StopPoint	Element	R	***AtcoCode,***	Yes	A-National
	Element	O	***NaptanCode***	Yes	A-National
StopArea (Cluster)r	Element	R	***StopAreaCode***	Yes	A-National
AdministrativeArea	Element	R	***AdminAreaCode***	No	A-National
NptgLocality	Element	R	***NptgLocalityCode***	Yes	A-National
ServicedOrganisation	Element	R	***OrganisationCode***	No	B-Various
Garage	Element	R	***GarageCode***	No	B-Operator
Service	Element	R	***ServiceCode,***	Yes	B-Operator
	Element	P	***TicketMachineServiceCode***		B-Operator
Operator	Element	O	***id***	No	C-Document
	Element	O	***NationalOperatorCode***		A-National
	Element	O	***OperatorCode***		B-Regional
	Element	O	***LicenceNumber***		A-National
Registration	Element	R	***VosaRegistrationNumber***	No	A-National
	Element	R	***/ TanCode***	No	A-National
	Element	R	***/ LicenceNumber***	No	A-National
	Element	R	***/ RegistrationNumber***	No	A-National
	Element	R	***VariationNumber***	No	B-Registration
Line	Element	R	***LineName***	No	B-Service
	Attribute	O	***id***		C-Document
Route	Attribute	O	***id***	Yes	C-Document
RouteSection	Attribute	O	***id***	No	C-Document
RouteLink	Attribute	O	***id***	No	C-Document
JourneyPattern	Attribute	O	***id***	Yes	C-Document
JourneyPatternSection	Attribute	O	***id***	No	C-Document
JourneyPatternTimingLink	Attribute	O	***id***	No	C-Document
JourneyPatternStopUsage	Attribute	O	***id***	No	C-Document
JourneyPatternInterchange	Attribute	O	***id***	No	C-Document
VehicleJourney	Element	R	***VehicleJourneyCode***	Yes	B-Service
	Element	O	***TicketMachineJourneyCode***		B-Service
VehicleJourneyTimingLink	Attribute	O	***id***	No	C-Document
VehicleJourneyStopUsage	Attribute	O	***id***	No	C-Document
VehicleJourneyInterchange	Attribute	O	***id***	No	C-Document
DeadRun	Attribute	O	***id***	No	C-Document
PositioningLink	Attribute	O	***id***	No	C-Document
LayoverPoint	Attribute	O	***id***	No	C-Document
Location	Attribute	O	***id***	No	C-Document
SupportingDocument	Element	R	***DocumentUri***	No	C-Document

Note	Element	*R*	***NoteCode***	No	B-Service

Table 3-23 – Main Entities of the TransXChange Model

The uniqueness scope of many identifiers is formally defined in the *TransXChange* schema by XML **keyref** constraints. See ‘Integrity Rules’ in *Section 14.*

3.16.1 Private codes

For a number of semantically significant elements, an additional ***PrivateCode*** element is supported. The ***PrivateCode*** facilitates the general purpose exchange of data in *TransXChange* format, as it allows instances to be annotated with the alternative identifier, so as to allow the unambiguous reconciliation of element identity between different computer systems on round trip exchanges. *Table 3-23* also indicates the elements that can have a ***PrivateCode.***

Note: Private codes are used in preference to XML ANY element types, as the latter cause a reduction in the efficacy of some commonly used validators.

3.16.2 Referencing Elements

A systematic convention is used to show the implementation of relationships (other than inline containment) between elements. For each entity that is referenced, a ***RefStructure*** is defined (based on the same type as the identifier of the referenced element), and this structure is used to type all references. This helps when reading the schema – if you see an element with REF on it, you know it implements a relationship with another entity. *Table 3-24* lists the elements that are referenced in various relationships.

Entity	Reference	Type	Scope
StopPoint	***StopPointRef***	***AtcoCodeType***	NaPTAN
StopArea	***StopAreaRef***	***StopAreaCodeType***	NaPTAN
AdministrativeArea	***AdministrativeAreaRef***	***AdminAreaCodeType***	NPTG
NptgLocality	***NptgLocalityRef***	***NptgLocalityCodeType***	NPTG
ServicedOrganisation	***ServicedOrganisationRef***	***OrganisationCodeType***	TransXChange
Garage	***GarageRef***	***GarageCodeType***	TransXChange
Service	***ServiceRef***	***ServiceCodeType***	TransXChange
Operator	***OperatorRef***	***idType***	TransXChange
Registration	***RegistrationRef***	***VosaRegistrationNumber Structure***	TransXChange
Line	***LineRef***	***idType***	TransXChange
Route	***RouteRef***	***idType***	TransXChange
RouteSection	***RouteSectionRef***	***idType***	TransXChange
RouteLink	***RouteLinkRef***	***idType***	TransXChange
JourneyPattern	***JourneyPatternRef***	***idType***	TransXChange
JourneyPatternSection	***JourneyPatternSectionRef***	***idType***	TransXChange
JourneyPatternTimingLink	***JourneyPatternTimingLinkRef***	***idType***	TransXChange
JourneyPatternStopUsage	***JourneyPatternStopUsageRef***	***idType***	TransXChange
JourneyPatternInterchange	***JourneyPatternInterchangeRef***	***idType***	TransXChange
VehicleJourney	***VehicleJourneyRef***	***VehicleJourneyCode***	TransXChange
VehicleJourneyTimingLink	***VehicleJourneyTimingLinkRef***	***idType***	TransXChange
VehicleJourneyStopUsage	***VehicleJourneyStopUsageRef***	***idType***	TransXChange
VehicleJourneyInterchange	***VehicleJourneyInterchangeRef***	***idType***	TransXChange
DeadRun	***DeadRunRef***	***idType***	TransXChange
PositioningLink	***PositioningLinkRef***	***idType***	TransXChange
LayoverPoint	***LayoverPointRef***	***idType***	TransXChange
Location	***LocationRef***	***idType***	TransXChange
SupportingDocument	***--***	***DocumentUri***	TransXChange
Note	***--***	***NoteCode***	TransXChange

Table 3-24 – References to Entities in the TransXChange Model

3.17 Data types

The following diagrams Figure 3-40, Figure 3-41, Figure 3-42, Figure 3-43, Figure 3-44, Figure 3-45, and Figure 3-46 summarise the base data types and enumerations used TransXChange.

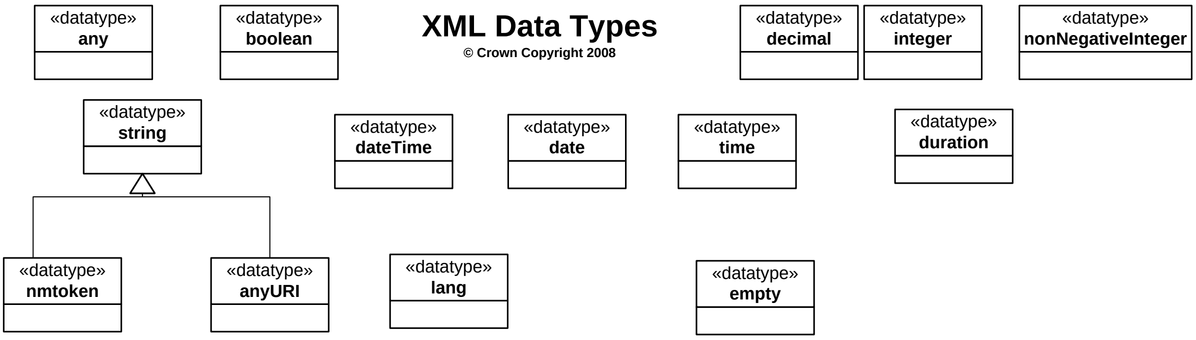


Figure 3-40 – UML Diagram of XML base Data types

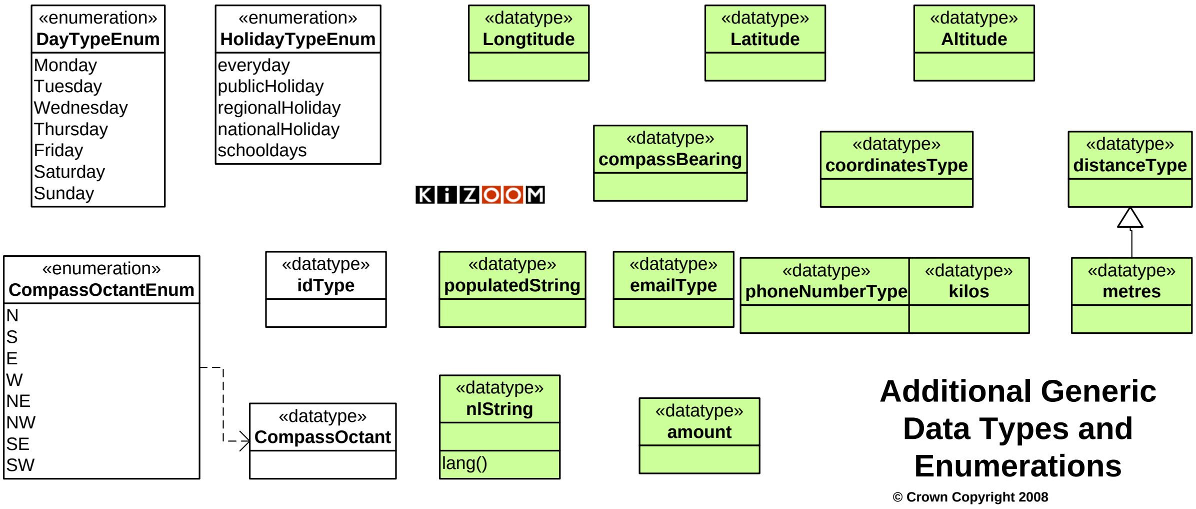


Figure 3-41 – UML Diagram of Additional base types use dby NaPTAN

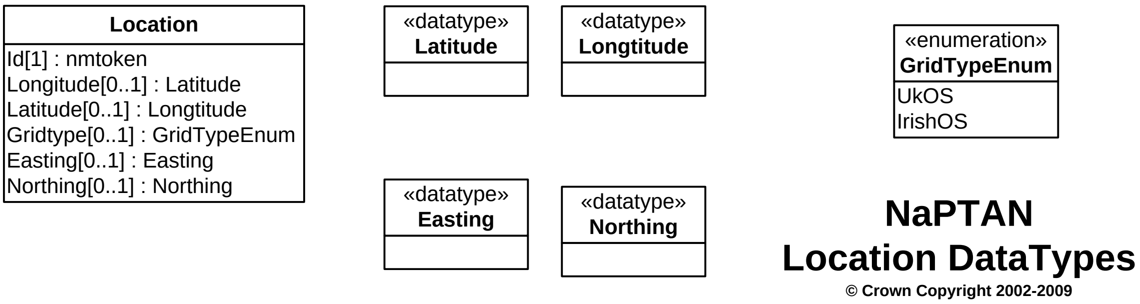

Location
Id[1] : nmtoken
Longitude[0..1] : Latitude
Latitude[0..1] : Longtitude
Gridtype[0..1] : GridTypeEnum
Easting[0..1] : Easting
Northing[0..1] : Northing
«datatype» Latitude
«datatype» Longtitude
«enumeration» GridTypeEnum
UkOS
IrishOS
«datatype» Easting
«datatype» Northing
NaPTAN Location DataTypes
© Crown Copyright 2002-2009

Figure 3-42 – UML Diagram of NaPTAN Location Types

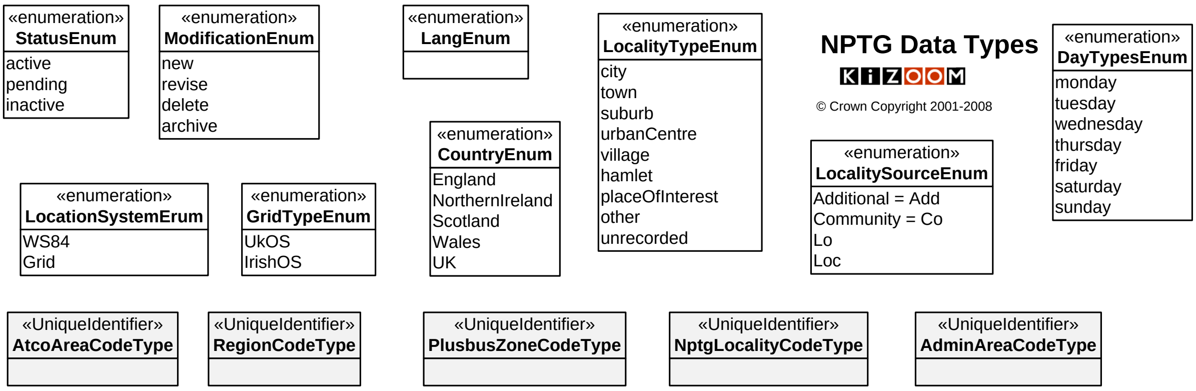


Figure 3-43 – UML Diagram of NPTG base types

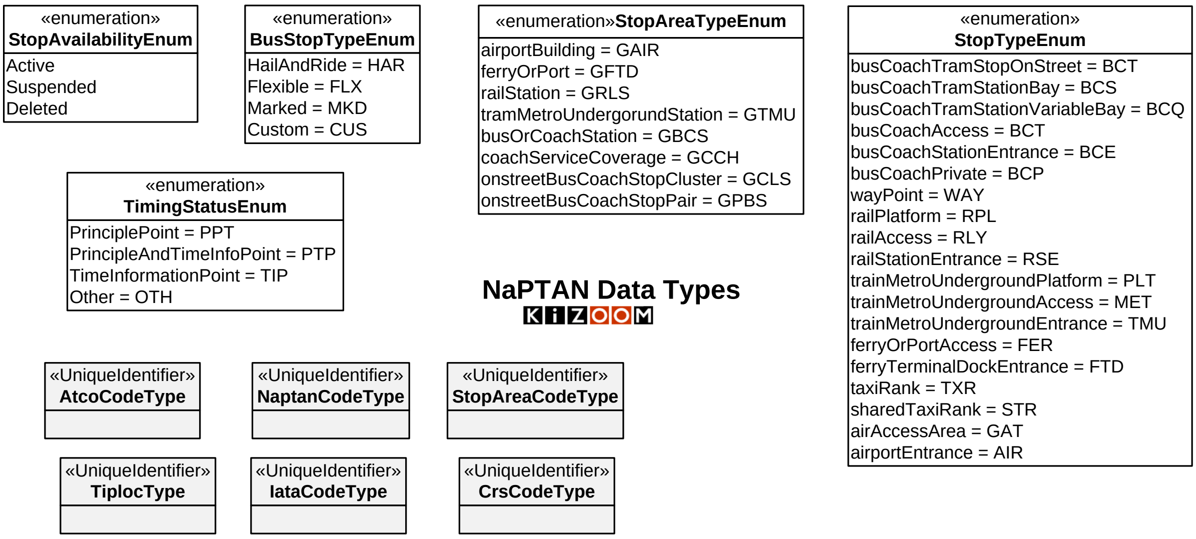


Figure 3-44 – UML Diagram of NaPTAn base types

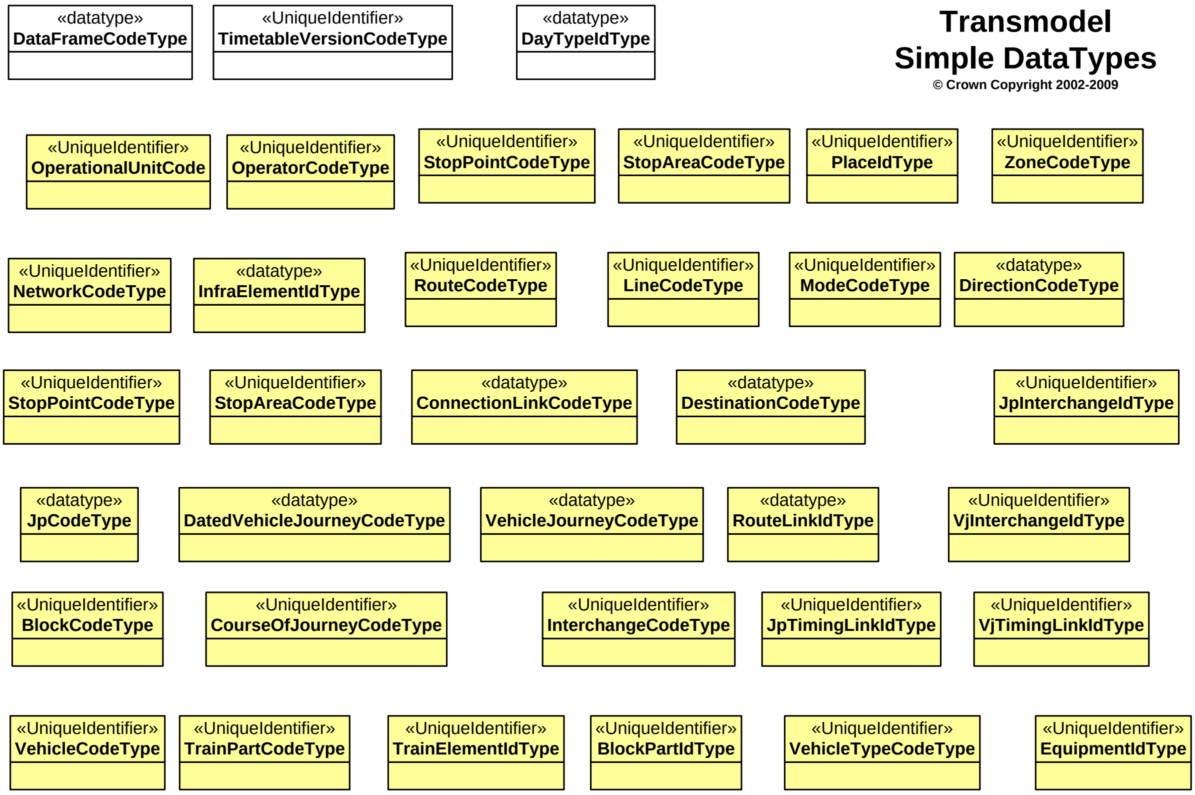


Figure 3-45 – UML Diagram of TransXChange simple identifier types

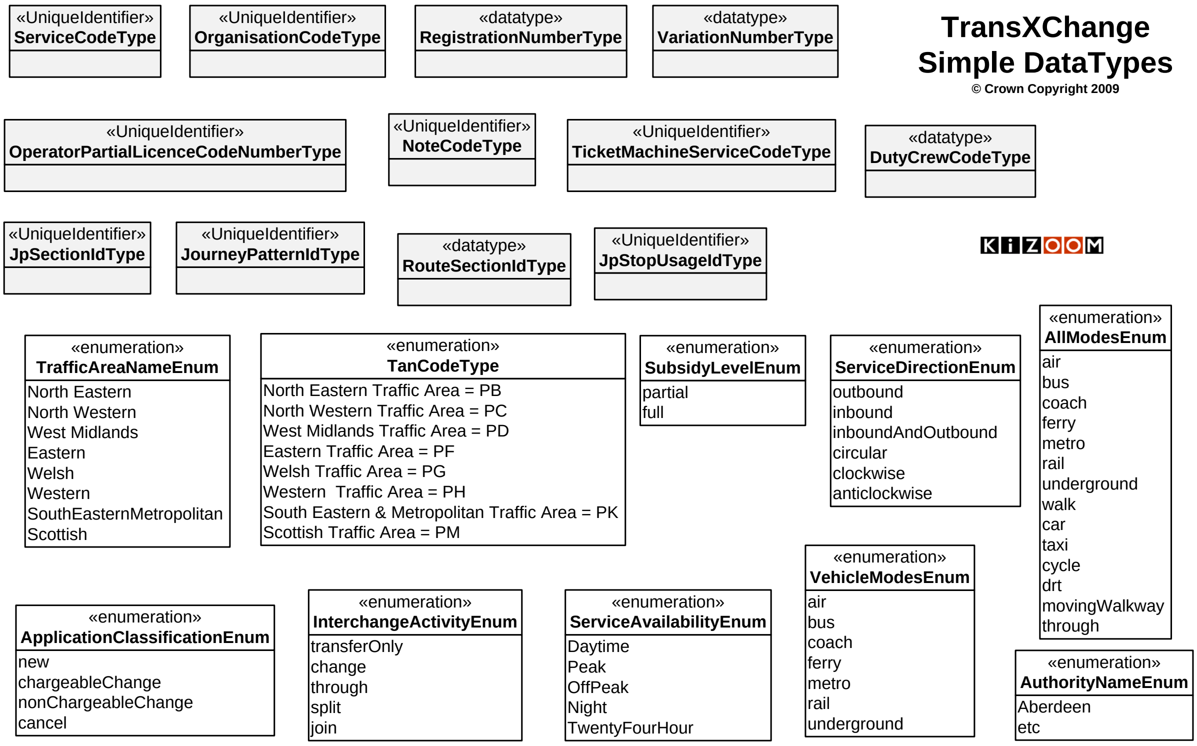


Figure 3-46 – UML Diagram of TransXChange other base types

4 WORKED EXAMPLE OF A TRANSXCHANGE SCHEDULE

This section provides a basic introductory example of using the main *TransXChange* elements. For more complex examples, refer to Section 5.

4.1 Worked Example: Bus Timetable

The elements of a *TransXChange* ***StandardService*** are illustrated using the fictional timetable shown in *Table 4-1*:

Service:	1, Suborn - Beall	Line:	1A	1B	1A	1C	1A	1B	1A
Origin:	Suborn, Bus Station								
Destination:	Beall, Bus Exchange								
Notes: Valid from 5 February until further notice									
Mondays to Fridays / Service on Mayday		Operator:	ACO	ACO	ACO	RED	ACO	ACO	ACO
		Journey:	37	38	39	40	41	42	43
Suborn, Bus Station		Depart:	15:55	16:15	16:35	16:40	16:55	17:15	17:35
Garden Village, Shop						16:46			
Robridge, Plough				16:26					
Barford, Red Lion		Arrive:	16:08	16:28	16:48	16:53	17:08	17:28	17:48
Barford, Red Lion		Depart:	16:09	16:29	16:49	16:54	17:09	17:29	17:49
Egham, Golden Lion			16:12		16:52	16:57	17:12		17:52
Godhill Church			16:15		16:55	17:00	17:15		17:55
Beall, Exchange			16:32	16:52	17:12		17:32	17:52	18:12
Beall Business Park, Shell				16:53		17:16		17:53	
Beall, Bus Station		Arrive:				17:17			

Table 4-1 – Worked Example: Bus Timetable

4.2 Worked Example: Service Components

To encode the example, we use a ***StandardService*** comprising:

- A ***LicensedOperator,*** who registers the service.
- A ***Registration,*** recording the statutory registration of the service with a TAN.
- A ***StandardService,*** recording the schedule of a fixed route service.
- A ***Route,*** over which the service runs from ***StopPoint*** to ***StopPoint***.
- A ***JourneyPattern,*** describing a general journey as a sequence of timing links.
- A collection of ***VehicleJourney*** instances, describing individual journeys as timing link sequences, and the departure times at which they run. Each ***VehicleJourney*** is based on a ***JourneyPattern*.**

4.3 Worked Example: Operator

Two types of operator can be defined for a service: the ***RegisteredOperator*** who registers the service, and one or more ***AssociatedOperator*** instances, who may perform subsidiary roles.

In the example case the registering ***LicensedOperator*** is '*ACO*', and the single associated ***Operator*** is '*RED*', who runs one particular journey on behalf of 'ACO'.

4.4 Worked Example: Registration

The ***Registration*** holds administrative details of the service registration, such as ***SubmissionDate***, ***SubmissionAuthor,*** and the ***TrafficAreas*** with full or partial responsibility for the registration of the submission.

4.5 Worked Example: StopPoints

A NaPTAN ***AnnotatedStopPoint*** instance is used to reference each of the vehicle stops where passengers may embark or disembark. Each of these identifies a NaPTAN point.

In the example there are nine stops, each with a specified type and sub type. See *Table 4-2.*

			Stop Point			
Sequence	**StopPoint / Name**	**StopPoint / Name**	**AtcoCode**	**NaPTAN Code (SMS number)**	**Stop Type**	**Sub Type**
#1	*Bus Station*	*Suborn*	*0600000001*	*chsadad*	*BCS*	*MKD*
#2	*Shops*	*Garden Village*	*0600000002*	*chsadag*	*BCT*	*MKD*
#3	*Plough*	*Robridge*	*0600000003*	*chsadaj*	*BCT*	*MKD*
#4	*Red Lion*	*Barford*	*0600000004*	*chsadam*	*BCT*	*MKD*
#5	*Golden Lion*	*Egham*	*0600000005*	*chsadap*	*BCT*	*MKD*
#6	*Church*	*Godhill*	*0600000006*	*chsadat*	*BCT*	*CUS*
#7	*Exchange*	*Beall*	*0600000007*	*chsadaw*	*BCT*	*MKD*
#8	*Shell*	*Beall*	*0600000008*	*chsadga*	*BCT*	*MKD*
#9	*Bus Station*	*Beall*	*0600000009*	*chsadgd*	*BCS*	*MKD*

Table 4-2 – Worked Example: StopPoint Instances

4.6 Worked Example: Route and Tracks

A ***Route*** describes the sequence of stop points of the route, and contains an ordered collection of references to ***RouteSection*** elements. Each ***RouteSection*** comprises an ordered collection of ***RouteLink*** elements, making up the detailed stop sequence of the route. Links always run from *NaPTAN* ***StopPoint*** to *NaPTAN* ***StopPoint***. The spatial path of each ***RouteLink*** is described by one or more ***Track*** elements, each having a ***Mapping***; a collection of points (***Location*** elements) giving the physical path of the route between stops.

Figure 4-1 shows an example route: The route links all have tracks comprising several location points.

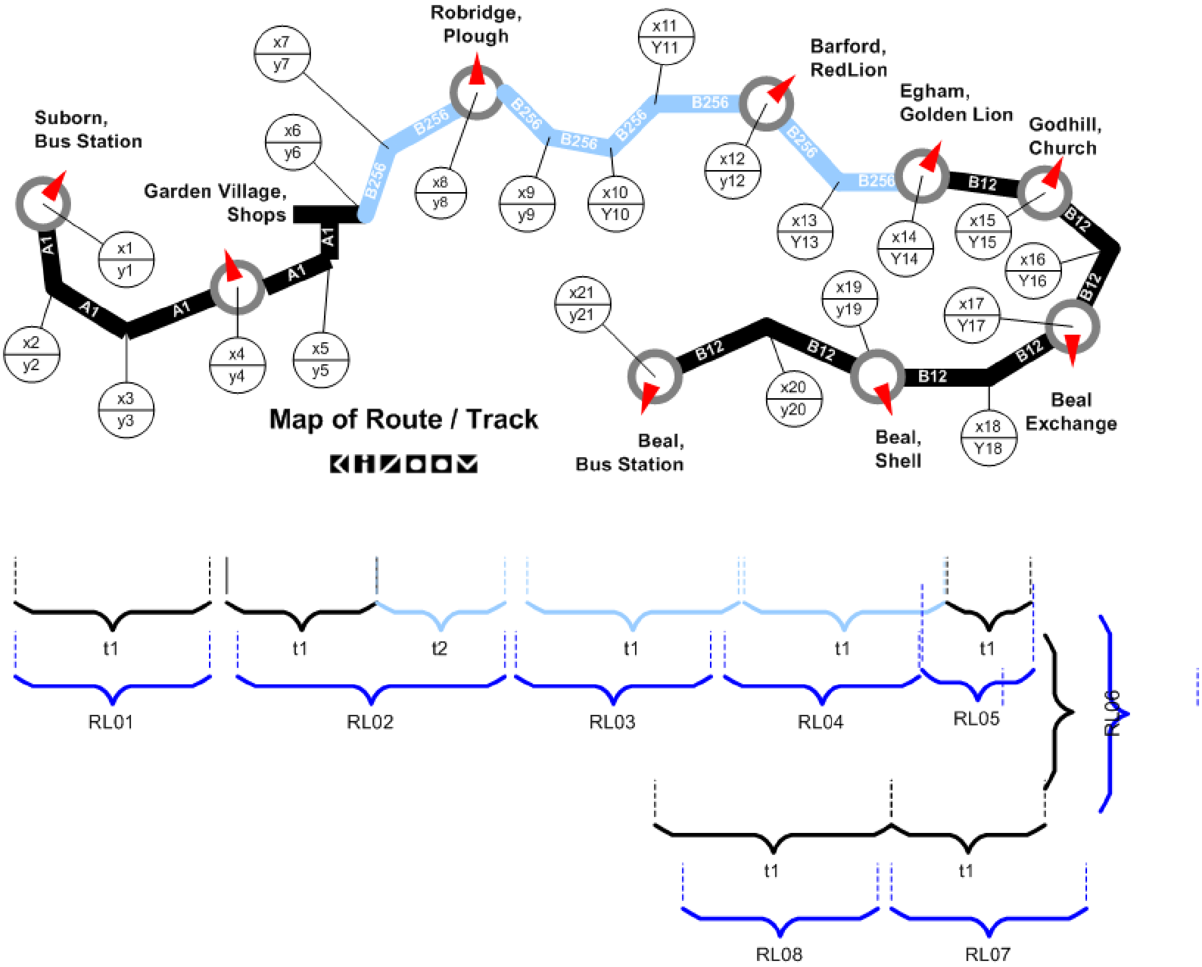


Figure 4-1 – Worked Example: Map of the Route

A single ***RouteSection***, with a link sequence of eight ***RouteLink*** instances (RL_01 – RL_08) suffices to connect the nine stops of the example, see *Table 4-3*. Each of the eight route links has a single ***Track***, except for the link between '*Garden Village'* and '*Robridge, Plough'*, which runs on two different roads (A1, B256), and so requires two track instance .*(T_2_1, T_2_2).* The tracks have a varying number of intermediate points, depending on their spatial depiction.

Link	Track	Origin	Destination	Mapping	Map Ref	Distance	Bearing
RL_01	*T_1_1*	*Suborn, Bus Station*	*Garden Village, Shops*	*(x_1,y_1) (x_2,y_2) (x_3,y_3) (x_4,y_4)*	*A1*	*5573*	*E*
RL_02	*T_2_1*	*Garden Village, Shops*	*(junction)*	*(x_4,y_4) (x_5,y_5) (x_6,y_6)*	*A1*	*4512*	*NE*
	T_2_2	*(junction)*	*Robridge, Plough*	*$x_6,y_6)$ (x_7,y_7) (x_8,y_8)*	*B256*		
RL_03	*T_3_1*	*Robridge, Plough*	*Barford, Red Lion*	*(x_8,y_8) (x_9,y_9) (x_{10},y_{10}) (x_{11},y_{11}) (x_{12},y_{12})*	*B256*	*6046*	*E*
RL_04	*T_4_1*	*Barford, Red Lion*	*Egham, Golden Lion*	*(x_{12},y_{12}) (x_{13},y_{13}) (x_{14},y_{14})*	*B256*	*2520*	*NE*
RL_05	*T_5_1*	*Egham, Golden Lion*	*Godhill, Church*	*(x_{14},y_{14}) (x_{15},y_{15})*	*B12*	*1955*	*SE*
RL_06	*T_6_1*	*Godhill, Church*	*Beall, Exchange*	*(x_{15},y_{15}) (x_{16},y_{16}) (x_{17},y_{17})*	*B12*	*2963*	*SW*
RL_07	*T_7_1*	*Beall, Exchange*	*Beall, Shell*	*(x_{17},y_{17}) (x_{18},y_{18}) (x_{19},y_{19})*	*B12*	*3560*	*SW*
RL_08	*T_8_1*	*Beall, Shell*	*Beall, Bus Station*	*(x_{19},y_{19}) (x_{20},y_{20}) (x_{21},y_{21})*	*B12*	*2005*	*SW*

Table 4-3 – Worked Example: RouteLink Instances

4.7 Worked Example: JourneyPattern

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.

To model the bus service in the worked example, one ***JourneyPattern*** instance is used that defines an overall sequence of stops.

- Three main vehicle journey instances *(37, 38* and *40*) are defined that reference the journey pattern; each vehicle journey omits particular stops (see *Figure 4-2*).
- Four other vehicle journey instances (*39, 41, 42* and *43*) are exact replicas of the first three vehicle journeys, apart from a different departure time, and so can be defined simply by referencing the links of the appropriate journey.

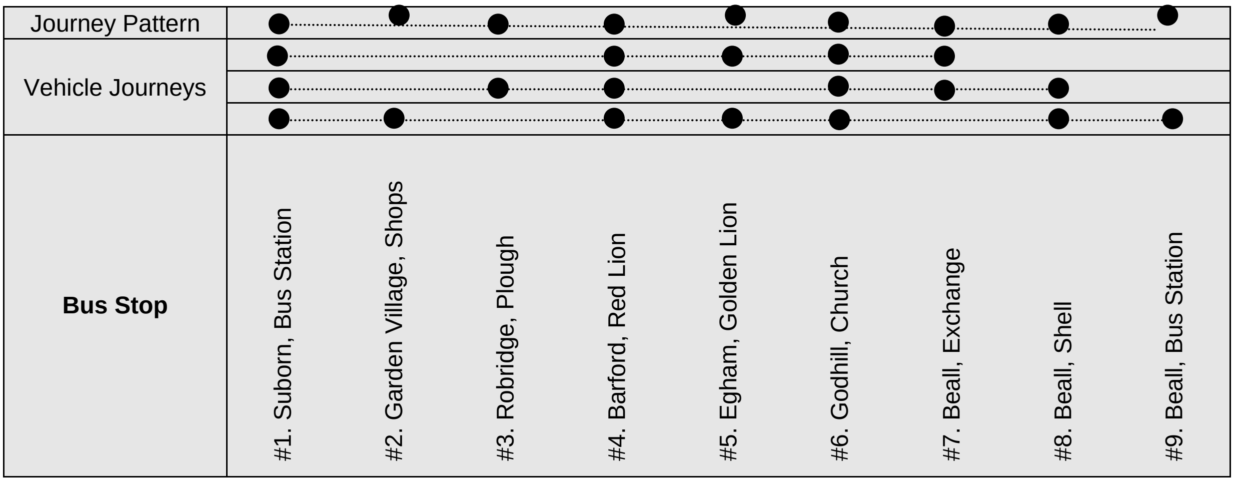


Figure 4-2 – Worked Example: Journey Pattern

The exact sequence of stops is given by a ***JourneyPattern.*** The journey pattern will also specify information about the use of the stop (which may vary according to service), in particular: The ***JourneyPatternTimingLink*** instances for the example journey pattern are shown in *Table 4-4.*

(i) The ***TimingStatus*** of each stop used in the route. Stops may be deemed *principal points* or *time information points,* or both. The principal points must appear in a timetable, and so are mandatory for *TransXChange*, while other stop points are non-enforceable stops of the journey:

(ii) The ***Activity*** that takes place at each stop. For example, picking up or setting down passengers. This may need to be overridden on individual vehicle journeys.

TimingLink Properties				**JourneyPatternStopUsage**					
Link id	**Run Time [sec]**	**Dist-ance [m]**	**id**	**StopPoint Ref**	**Stop Name**	**Tim-ing Status**	**Wait Tim e**	**Activity**
JL_1 #1-#2	360	5.573	JL_1a	0600000001	Suborn, Bus Station	*PTP*	0	*PickUp*
			JL_1b	0600000002	Garden Village, Shops	*PTP*	0	*PickUpAndSetDown*
JL_2 #2-#3	300	4.512	JL_2a	0600000002	Garden Village, Shops	*PTP*	0	*PickUpAndSetDown*
			JL_2b	0600000003	Robridge, Plough	*PTP*	0	*PickUpAndSetDown*
JL_3 #3-#4	120	6.046	JL_3a	0600000003	Robridge, Plough	*PTP*	0	*PickUpAndSetDown*
			JL_3b	0600000004	Barford, Red Lion	*PTP*	60	*PickUpAndSetDown*
JL_4 #4-#5	180	2.520	JL_4a	0600000004	Barford, Red Lion	*PTP*	60	*PickUpAndSetDown*
			JL_4b	0600000005	Egham, Golden Lion	*TIP*	0	*PickUpAndSetDown*

JL_5 #5-#6	180	1.955	JL_5a	0600000005	Egham, Golden Lion	*TIP*	0	*PickUpAndSetDown*
			JL_5b	0600000006	Godhill, Church	*TIP*	0	*PickUpAndSetDown*
JL_6 #6-#7	420	2.963	JL_6a	0600000006	Godhill, Church	*TIP*	0	*PickUpAndSetDown*
			JL_6b	0600000007	Beall, Exchange	*PTP*	0	*PickUpAndSetDown*
JL_7 #7-#8	60	3.560	JL_7a	0600000007	Beall, Exchange	*PTP*	0	*PickUpAndSetDown*
			JL_7b	0600000008	Beall, Shell	*TIP*	0	*PickUpAndSetDown*
JL_7 #8-#9	60	2.005	JL_8a	0600000008	Beall, Shell	*TIP*	0	*PickUpAndSetDown*
			JL_8b	0600000009	Beall, Bus Station	*PTP*	0	*SetDown*

Table 4-4 – Worked Example: Timing Links for Journey Pattern

4.8 Worked Example: Line

Line elements are used to model the labelling of lines for the public. A service may have a number of lines, each with a ***LineName***, and each vehicle journey can be assigned to a line. Normally, the same line is used to label vehicle journeys following the same pattern, but sometimes different journey variants with distinct patterns and link sequences may all be labelled under the same line name (though usually they will always have at least a few stops in common). Note that each ***VehicleJourney*** has a ***VehicleJourneyCode*** that is quite independent of the ***Line*** and ***LineName*** with which it may be associated.

In our example, there are three line names '1A'*, '1B'*, and *'1C'*, used to distinguish the different journeys that follow the three different journey patterns

4.9 Worked Example: VehicleJourney

A ***VehicleJourney*** represents the traversal of a journey pattern at a particular time, and is composed of an ordered collection of ***VehicleJourneyTimingLink*** instances.

The timing links for ***VehicleJourney*** '40' of the worked example are shown in *Table 4-5*. Two stops are skipped: '*Robridge, Plough'* and '*Beall Bus Exchange'*.

TimingLink Properties			**VehicleJourneyStopUsage**					
id	**Run Time [sec]**	**JL Ref**	**id**	**StopPoint Usage**	**Stop Name**	**Stop Class**	**Wait Time**	**Activity**
VL_1 #1-#2	360	JL_1	VL_1a	0600000001	Suborn, Bus Station	BCT	0	pickUp
			VL_1b	0600000002	Garden Village, Shops	BCT	0	setDown
VL_2# 2-#3	300	JL_2	VL_2a	0600000002	Garden Village, Shops	BCT	0	pickUp
			VL_2b	0600000003	Robridge, Plough	BCT	0	**pass**
VL_3# 3-#4	120	JL_3	VL_3a	0600000003	Robridge, Plough	BCT	0	**pass**
			VL_3b	0600000004	Barford, Red Lion	BCT	60	setDown
VL_4# 4-#5	180	JL_4	VL_4a	0600000004	Barford, Red Lion	BCT	60	pickUp
			VL_4b	0600000005	Egham, Golden Lion	BCT	0	setDown
VL_5 #5-#6	180	JL_5	VL_5a	0600000005	Egham, Golden Lion	BCT	0	pickUp
			VL_5b	0600000006	Godhill, Church	BCT	0	setDown
VL_6 #6-#7	420	JL_6	VL_6a	0600000006	Godhill, Church	BCT	0	pickUp
			VL_6b	0600000007	Beall, Bus Exchange	BCT	0	**pass**
VL_7 #7-#8	60	JL_7	VL_7a	0600000007	Beall, Bus Exchange	BCT	0	**pass**
			VL_7b	0600000008	Beall, Shell	BCT	0	setDown
VL_7 #8-#9	60	JL_7	VL_8a	0600000008	Beall, Shell	BCT	0	pickUp
			VL_8b	0600000009	Beall, Bus Station	BCT	0	setDown

Table 4-5 – Worked Example: Timing Links for VehicleJourney 1A

4.10 Worked Example: Operational Times

The operational times of the example are modelled as follows:

- There is a ***Service*** / ***ValidityPeriod*** from '5th February 2001' until further notice.
- The ***OperatingProfile*** / ***RegularDayType*** / will show ***MondayToFriday*** operation.
- The ***OperatingProfile*** / ***BankHolidayOperation*** / ***DaysOfOperation*** / has a Value of ***MayDay*** to show that it runs on Mayday.

- The ***OperatingProfile*** / ***BankHolidayOperation*** / ***DaysOfNonOperation*** / has a Value of ***Christmas*** to show that it does not run on Christmas or Boxing Day.

5 EXAMPLES

TransXChange is accompanied by a set of examples designed to illustrate the use of each of its features. For each example, a web page with links to the following is provided:

- Summary of features demonstrated by example.
- A route map.
- A matrix timetable representation.
- The XML encoding of the example.
- The *TransXChange Publisher* output of the encoded XML document.
- Explanatory notes describing the representation and implementation of specific features.

The examples can be found at http://www.transxchange.org.uk/examples.htm.

Table 5-1 lists the *TransXChange* examples, with the features covered by each case.

Group	**Topology**	**Features covered**
Basic	**Linear** A single straight route. All vehicle journeys have the same timings	• Linear route. • Registration details. • RouteTrack maps • Tracks, including instructions and Mapping System References. • Frequency based journey times, specified as an interval. • Registration Schema.
	Express A linear route with express journey patterns	• Express service. • Reuse of vehicle journey timing links in multiple journeys. • Holiday day type exclusions. • Local stop point definitions for an off-street bus station: BCQ and BCS stop types. • Local stop area definitions. • Variable bay allocation. • Supporting document. • General Schema.
Complex	**Interchange** Two patterns run by two different operators presented as the same Service. All vehicle journeys have the same timings.	• An Interchange. • Linear route, with different stop visiting pattern at one end. • Express stops. • Frequency based journey times, specified as an interval. • Combining operating days from service, journey pattern and vehicle journey level. • Serviced organisation & school dates. • More than one operator. • Timetable notes. • Inward and outward timetables for the same service, using a single route. • Registration Schema.
	Circular A circular route.	• Circular route. • Reuse of route sections. • Dead runs (positioning links). • Partial traversal of a journey pattern. • Operator Garage. • AVL data - Vehicle type ticket machine, duty crew. • WGS84. • Block (Running Board). • General Schema.

	Cloverleaf A cloverleaf route shape with three petals	• Multiple routes composed of common route sections. • Multiple journey patterns composed of common. Journey pattern sections. • Dynamic destination display. • General Schema.
	Lollipop A lollipop" shaped route, with two parallel branches.	• Circular and parallel sections. • Reuse of journey pattern sections. • Stop Sequence Numbers. • Layover Point. • Connecting services. • General Schema.
	Eye An 'eye' shaped route, with two alternative branches.	• Multiple routes composed of common route sections. • Multiple journey patterns composed of common. Journey pattern sections. • Stop Sequence Numbers. • Local stop point definitions. • Bilingual stop names & schedule (Cymraeg). • Block (Running Board). • Registration Schema.
	Flexible Use of flexible zones	• Flexible zones. • Flexible time bands. • Registration Schema.
	Hail & Ride Use of hail and ride stops	• Hail and ride sections. • Local stop point definitions. • Full lollipop topology. • Frequent service journey times, specified as minutes past the hour. • Short notice registration details. • Registration Schema
	Large Route Very large timetable	• More stops than fit on a page. • More journeys than fit on a page.

Table 5-1 – TransXChange Examples

6 TRANSXCHANGE SCHEMA

TransXChange describes bus schedules as a model of XML elements, contained within a ***TransXChange*** root element. In this section we describe the different types of schema elements in detail.

6.1 TransXChange Schema Overview

In a *TransXChange* document, data is organised around two main element types; ***Service*** (which may contain either or both ***StandardService*** or ***FlexibleService*** elements) and ***VehicleJourney***, which together combine the instances of other elements into descriptions of bus schedules. ***Service*** instances are grouped under the ***TransXChange*** root element within a ***Services*** container, and ***VehicleJourney*** instances in a ***VehicleJourneys*** container. Other high-level elements such as ***Operator, Registration, RouteSection*** and ***JourneyPatternSection*** are also declared globally within containers under the ***TransXChange*** root element so that they may be reused in many different services (or even outside the context of a service, for general exchange).

The ***TransXChange*** element thus contains a number of different child and descendant elements (*Figure 6-1*) which can be characterised as falling into four groups:

- *Topographical* elements: ***StopPoint***, ***StopArea***, ***NptgLocality***, ***ServicedOrganisation.***
- *Route* and Network *topology* elements: ***Route***, ***RouteSection, RouteLink***.
- *Service Supply* elements: ***Service***, (***StandardService***, ***FlexibleService, Line, JourneyPattern), JourneyPatternSection, VehicleJourney.***
- *Registration Elements:* ***Operator, Registration, (ShortNoticeRegistration).***
- *Ancillary* elements: ***SupportingDocument***.

6.2 TransXChange Root Element

Every *TransXChange* document has a single instance of the ***TransXChange*** root element, which contains all the other elements.

6.2.1 TransXChange Element Attributes

The ***TransXChange*** element has the following attributes:

- ***xml:lang:*** Default language of document. ISO language identifier. Default is English.
- Change Management attributes:
  - ***CreationDateTime***: Timestamp of document creation date and time.
  - ***ModificationDateTime:*** Timestamp of document last modification date and time.
  - ***Modification:*** Nature of update ***'****New', 'Revise', 'Delete'****.***
  - ***RevisionNumber:*** Monotonically increasing version number.
  - ***FileName:*** Name of file containing the document.
- ***SchemaVersion:*** *TransXChange* schema version identifier used for the document content model. Fixed: must be the schema version, e.g. *'2.0'*.
- ***MappingSystem:*** Data system to use for mapping references ('*OS', 'Navtech'*, etc) within the document.
- ***LocationSystem:*** Data system to use for location coordinate references within the document: '*WGS84'* or '*Grid'*. Must be '*Grid'* for registration documents.
- ***RegistrationDocument:*** Whether the document should be published as a registration, i.e. satisfy the additional semantic integrity constraints. Boolean.

6.2.2 TransXChange Child Elements

The ***TransXChange*** element comprises the following child elements:

- ***ServicedOrganisations***: A collection of ***ServicedOrganisation*** elements. See later.
- ***NptgLocalities***: A collection of references to NPTG *localities* used in local stop definitions in the schedule. See later.
- ***StopPoints***: A collection of the *NaPTAN* stop points used in the schedule. See later.
- ***StopAreas***: A collection of reusable ***StopArea*** instances declared locally to group any stop points declared locally. See later.
- ***RouteSections***: A collection of reusable ***RouteSection*** elements for defining routes. See later.
- ***Routes***: A collection of reusable ***Route*** elements for use in journey patterns. See later.
- ***JourneyPatternSections***: A collection of reusable ***JourneyPatternSection*** elements for defining journey patterns. See later.
- ***Operators***: A collection of ***Operator*** elements. See later.
- ***Services***: A collection of ***Service*** elements. See later.
- ***VehicleJourneys***: A collection of ***VehicleJourney*** elements. See later.
- ***Registrations***: A collection of ***Registration*** elements, each referencing a ***Service*** element. See later.
  - In the *TransXChange Registration Schema*, there must be one ***Registration.***
  - In the *TransXChange General Schema* documents, there may be zero, one or many ***Registration*** instances.
- ***SupportingDocuments***: A collection of reusable ***SupportingDocument*** elements. See later.

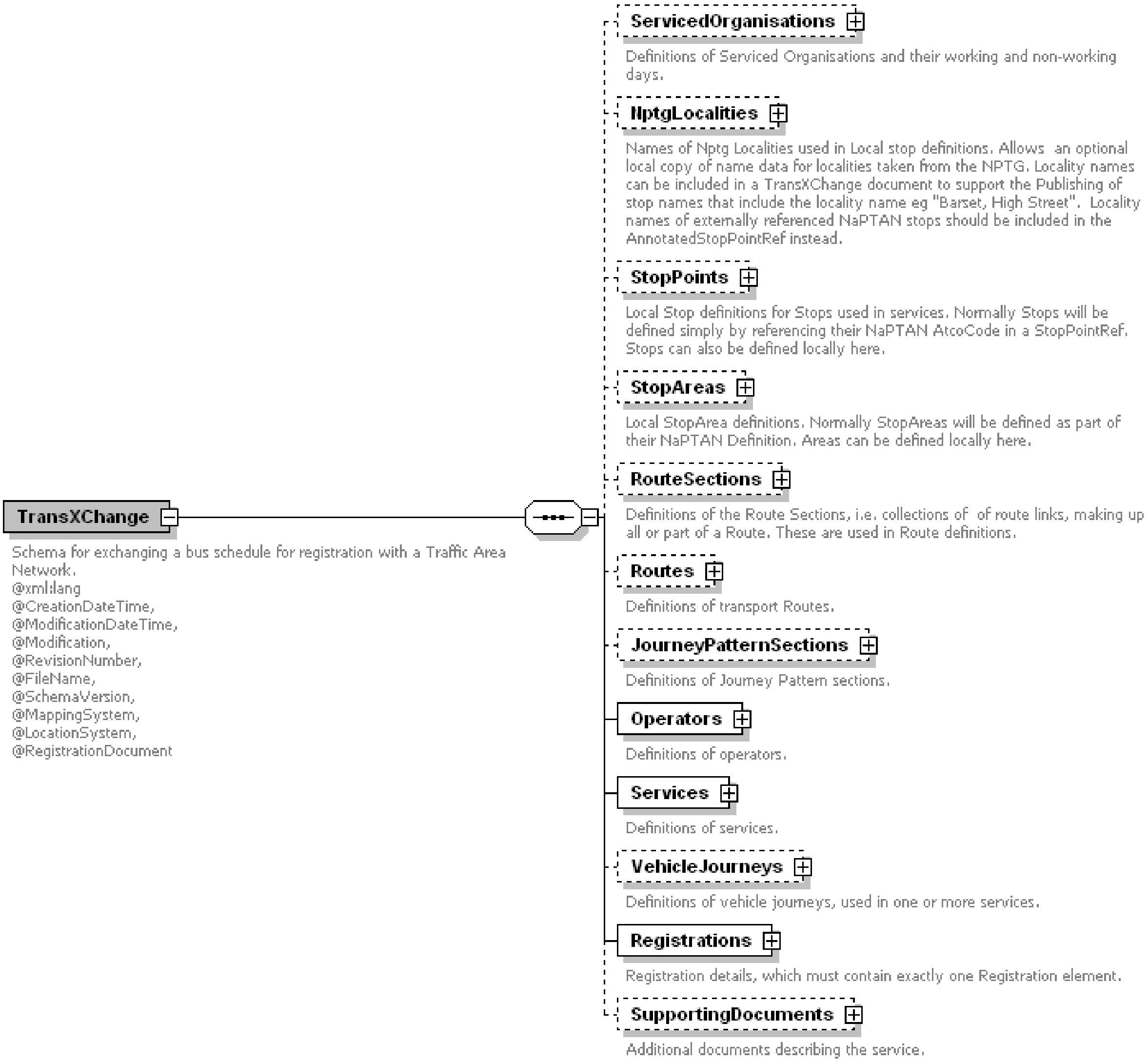

ServicedOrganisations
Definitions of Serviced Organisations and their working and non-working days.
NptgLocalities
Names of Nptg Localities used in Local stop definitions. Allows an optional local copy of name data for localities taken from the NPTG. Locality names can be included in a TransXChange document to support the Publishing of stop names that include the locality name eg "Barset, High Street". Locality names of externally referenced NaPTAN stops should be included in the AnnotatedStopPointRef instead.
StopPoints
Local Stop definitions for Stops used in services. Normally Stops will be defined simply by referencing their NaPTAN AtcoCode in a StopPointRef. Stops can also be defined locally here.
StopAreas
Local StopArea definitions. Normally StopAreas will be defined as part of their NaPTAN Definition. Areas can be defined locally here.
RouteSections
Definitions of the Route Sections, i.e. collections of of route links, making up all or part of a Route. These are used in Route definitions.
TransXChange
Schema for exchanging a bus schedule for registration with a Traffic Area Network.
@xml:lang
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber,
@FileName,
@SchemaVersion,
@MappingSystem,
@LocationSystem,
@RegistrationDocument
Routes
Definitions of transport Routes.
JourneyPatternSections
Definitions of Journey Pattern sections.
Operators
Definitions of operators.
Services
Definitions of services.
VehicleJourneys
Definitions of vehicle journeys, used in one or more services.
Registrations
Registration details, which must contain exactly one Registration element.
SupportingDocuments
Additional documents describing the service.

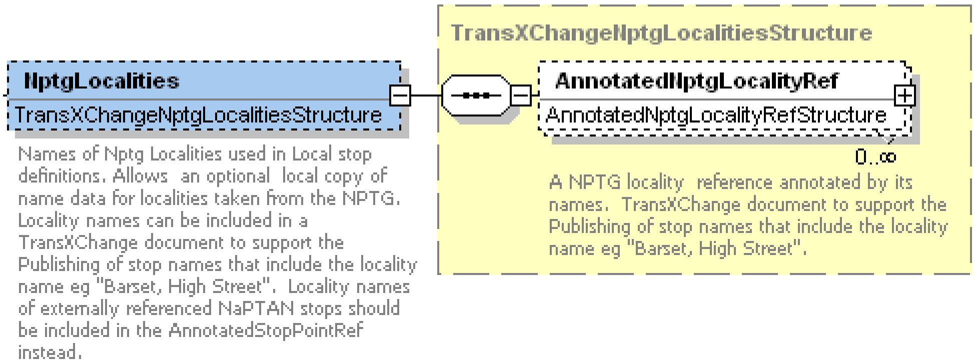
Figure 6-1 – Top Level Elements of TransXChange

6.3 Topographical Elements – StopPoints and Zones

6.3.1 NptgLocalities Element

The use of stops in *TransXChange* is based on *NaPTAN.* See the ***StopPoints*** element which allows stop usages to be declared. All stops are assigned to an *NPTG* Locality by means of a reference to a NPTG Locality identifier. When publishing the stop with a tool such as the *TransXChange Publisher*, the bus stop common names may be qualified with a locality name, for example “*Barset, High Street”,* rather than just *“High Street”.* It is therefore desirable that a *TransXChange* document contain the NPTG locality names so that a document can be published without recourse to the NPTG database. For stops that are externally referenced (using an ***AnnotatedStopPointRef*** instance), the ***NptgLocality LocalityName*** can be included as an annotation on the stop point reference. However for new stops that are defined locally using a ***StopPoint*** element, the locality names need to be supplied with a separate ***AnnotatedNptgLocalityRef,*** as they are not part of a new ***StopPoint*** declaration.

- ***NptgLocalities***: A collection of ***AnnotatedNptgLocalityRef*** instances to . See below.


NptgLocalities
TransXChangeNptgLocalitiesStructure
TransXChangeNptgLocalitiesStructure
AnnotatedNptgLocalityRef
AnnotatedNptgLocalityRefStructure
0..∞

Names of Nptg Localities used in Local stop definitions. Allows an optional local copy of name data for localities taken from the NPTG. Locality names can be included in a TransXChange document to support the Publishing of stop names that include the locality name eg "Barset, High Street". Locality names of externally referenced NaPTAN stops should be included in the AnnotatedStopPointRef instead.

A NPTG locality reference annotated by its names. TransXChange document to support the Publishing of stop names that include the locality name eg "Barset, High Street".

Figure 6-2 – NptgLocalities Element

6.3.2 AnnotatedNptgLocalityRef Element

Each ***AnnotatedNptgLocalityRef*** instance provides a local copy of *NPTG* Locality name information that can be used without recourse to the full *NPTG* database.

- ***NptgLocalityRef:*** Unique *NPTG* Locality identifier, i.e. ***NptgLocalityCode*** of ***NptgLocality***
- ***LocalityName:*** Text name of ***NptgLocality;*** this name can be repeated locally so that the schedule may be annotated by tools such as the *TransXChange Publisher* without necessarily accessing the full *NPTG* database.
- ***LocalityQualifier:*** Any Qualifier of text name of locality, for example “Kent” to distinguish ‘*Ashford (Kent)’* from ‘*Ashford (Middlesex)*.

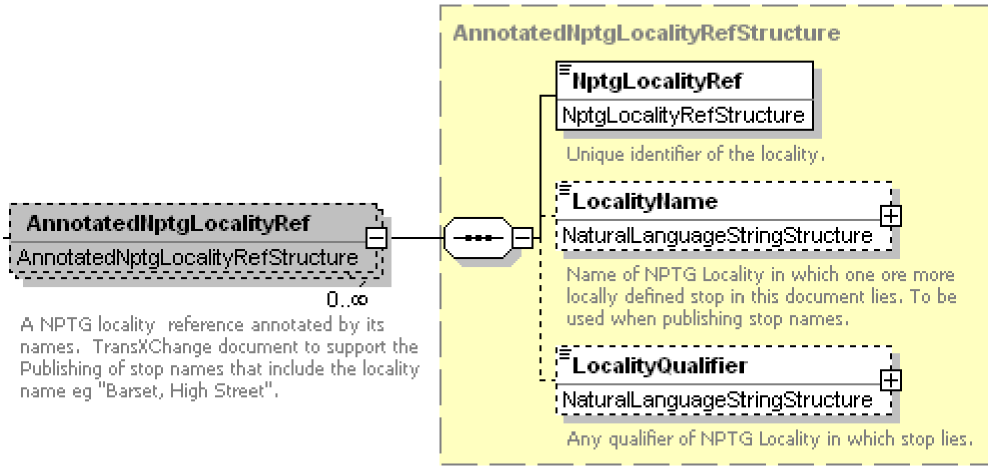

AnnotatedNptgLocalityRefStructure
NptgLocalityRef
NptgLocalityRefStructure
Unique identifier of the locality.
LocalityName
NaturalLanguageStringStructure
Name of NPTG Locality in which one ore more locally defined stop in this document lies. To be used when publishing stop names.
LocalityQualifier
NaturalLanguageStringStructure
Any qualifier of NPTG Locality in which stop lies.
AnnotatedNptgLocalityRef
AnnotatedNptgLocalityRefStructure
0..∞
A NPTG locality reference annotated by its names. TransXChange document to support the Publishing of stop names that include the locality name eg "Barset, High Street".

Figure 6-3 – AnnotatedNptgLocalityRef Element

6.3.3 StopPoints Element

The use of stops in *TransXChange i*s based on *NaPTAN.* The ***StopPoints*** element (*Figure 6-4)* contains reusable declarations of the stops used by the routes and journey patterns of the schedule. All ***StopPointRef*** instances elsewhere in a document are resolved against the contents of the ***StopPoints*** element.

- Existing *NaPTAN* ***StopPoint*** instances can be referred to simply by using an ***AnnotatedStopPointRef*** to reference a *NaPTAN* system stop identifier – the ***AtcoCode*** of the stop. For further details refer to the *NaPTAN Schema Guide.*
- New stops may also be declared within a *TransXChange* XML document, by means of a local ***StopPoint*** declaration within the ***StopPoints*** container element.

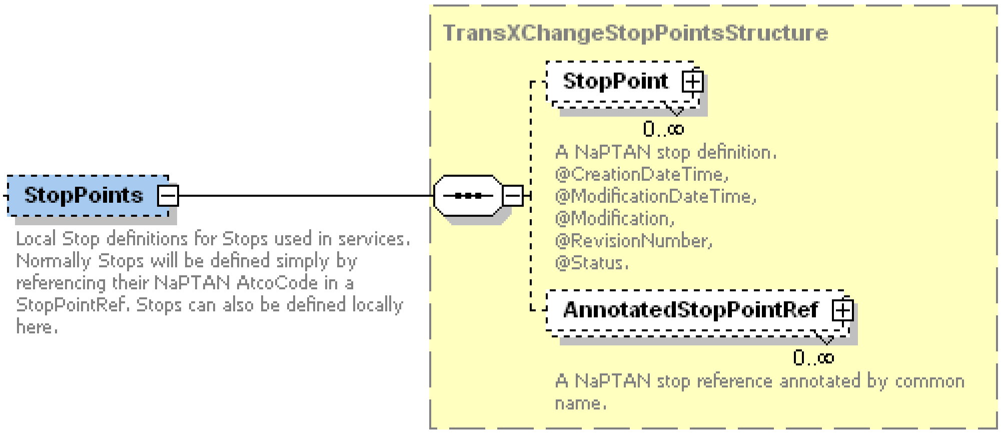

TransXChangeStopPointsStructure
StopPoint
0..∞
A NaPTAN stop definition. @CreationDateTime, @ModificationDateTime, @Modification, @RevisionNumber, @Status.
AnnotatedStopPointRef
0..∞
A NaPTAN stop reference annotated by common name.
StopPoints
Local Stop definitions for Stops used in services. Normally Stops will be defined simply by referencing their NaPTAN AtcoCode in a StopPointRef. Stops can also be defined locally here.

Figure 6-4 – StopPoints Element

6.3.4 AnnotatedStopPointRef Element

The ***AnnotatedStopPoint*** element (*Figure 6-5*) references an existing *NaPTAN* stop and comprises the following elements:

- ***StopPointRef:*** Unique *NaPTAN* identifier, i.e. ***AtcoCode*** of ***StopPoint***.
- ***CommonName:*** Common text name of ***StopPoint;*** this name is repeated locally so that the schedule may be interpreted by tools such as the *TransXChange Publisher* without necessarily accessing the full *NaPTAN* database.
- ***Indicator:*** Further structured text descriptor element of ***StopPoint;*** that is used to distinguish similar stops, for example bus station bays.

- ***LocalityName:*** Text name of ***NptgLocality;*** this name can be repeated locally so that the schedule may be annotated by tools such as the *TransXChange Publisher* without necessarily accessing the full *NPTG* database.
- ***LocalityQualifier:*** Any Qualifier of text name of locality, for example "Kent" to distinguish '*Ashford (Kent)'* from '*Ashford (Middlesex)*.

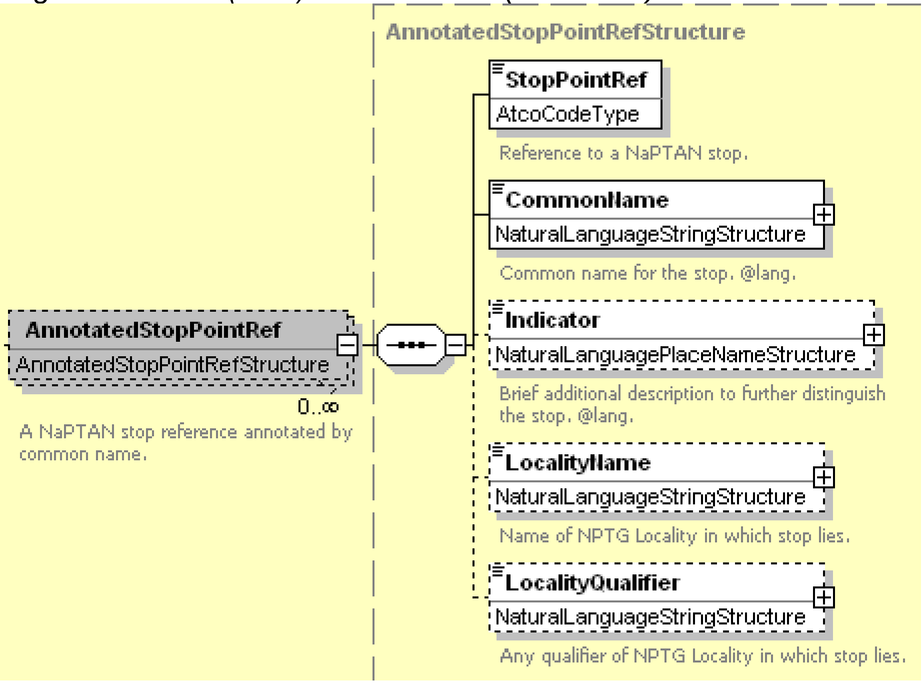

AnnotatedStopPointRefStructure
StopPointRef
AtcoCodeType
Reference to a NaPTAN stop.
CommonName
NaturalLanguageStringStructure
Common name for the stop. @lang.
AnnotatedStopPointRef
AnnotatedStopPointRefStructure
0..∞
A NaPTAN stop reference annotated by common name.
Indicator
NaturalLanguagePlaceNameStructure
Brief additional description to further distinguish the stop. @lang.
LocalityName
NaturalLanguageStringStructure
Name of NPTG Locality in which stop lies.
LocalityQualifier
NaturalLanguageStringStructure
Any qualifier of NPTG Locality in which stop lies.

Figure 6-5 – Annotated StopPointRef Element

6.3.5 StopPoint Element (Stop)

The ***StopPoint*** element declares locally defined stops. A local ***StopPoint*** declaration uses *NaPTAN* elements, and must include a *NaPTAN* identifier for the stop. Local declarations are for expediency in cases when the *NaPTAN* definition for a new stop has not yet been promulgated to the *NaPTAN* database. Even then, the *NaPTAN* identifier for such stops must be allocated by the relevant local transport authority. The other details of the stop may change subsequently in the course of registering it with the Authority.

Refer to the *NaPTAN* 2.0 *Schema Guide* for a definition of the ***StopPoint*** Element and its subelements.

6.3.6 StopArea Element (StopGroup / StopCluster)

A ***StopArea*** is used to group stops: locally declared ***StopPoint*** instances can be assigned to one or more stop areas.

- *NaPTAN* stops that exist in the *NaPTAN* database may already have a ***StopArea*** element (previously called a ***StopGroup***) associated with them.
- Local definitions of individual ***StopArea*** elements may also be declared within the ***StopAreas*** element of the ***TransXChange*** root element. Each ***StopArea*** must have a ***StopAreaCode***. Local stop area declarations are for expediency in cases when the *NaPTAN* definition for a new stop area has not yet been promulgated to the *NaPTAN* database.
- Locally declared ***StopPoint*** elements may reference one or more ***StopArea*** instances.

- When importing schedules, an application will attempt to find the ***StopArea*** details in the *NaPTAN* database using the ***StopAreaCode***. Only if no ***StopArea*** is found for the code will the locally supplied definition be used.

A *NaPTAN* ***StopArea*** is identified by an ***AreaCode,*** a unique *NaPTAN* identifier of the stop area.

Refer to the *NaPTAN* 2.0 *Schema guide* for a definition of the ***StopArea*** Element and its subelements.

6.4 Network Topology Elements – Routes and Tracks

6.4.1 Route Element

A ***Route*** (*Figure 6-6*) describes the physical traversal of a bus along a route, described as an ordered collection of ***RouteLink*** elements, grouped into ***RouteSection*** elements. It is identified by a unique ***id*** attribute, and has the following properties:

- ***PrivateCode***: an optional cross reference to an external system identifier for the route.
- ***Description:*** A textual description of the route.
- ***RouteSectionRef***: An ordered collection of one or more references to ***RouteSection*** elements that contain the route links making up the route.
- ***ReversingManouevre:*** Used to describe any reversing manoeuvres needed.

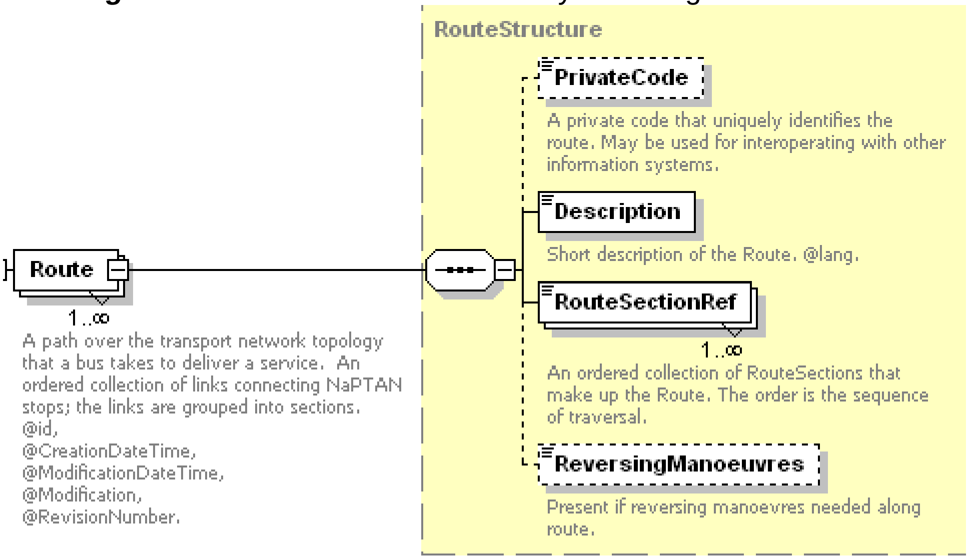

RouteStructure
PrivateCode
A private code that uniquely identifies the route. May be used for interoperating with other information systems.
Description
Short description of the Route. @lang.
Route
1..∞
A path over the transport network topology that a bus takes to deliver a service. An ordered collection of links connecting NaPTAN stops; the links are grouped into sections.
@id,
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.
RouteSectionRef
1..∞
An ordered collection of RouteSections that make up the Route. The order is the sequence of traversal.
ReversingManoeuvres
Present if reversing manoevres needed along route.

Figure 6-6 – Route Element

6.4.2 RouteSection Element

A ***RouteSection*** (*Figure 6-7*) describes the course of a section of a route between several *NaPTAN* stops, and comprises an ordered collection of ***RouteLink*** elements, each describing a stop-to-stop path. A ***RouteSection*** can be used in multiple routes. It is identified by a unique ***id*** attribute.

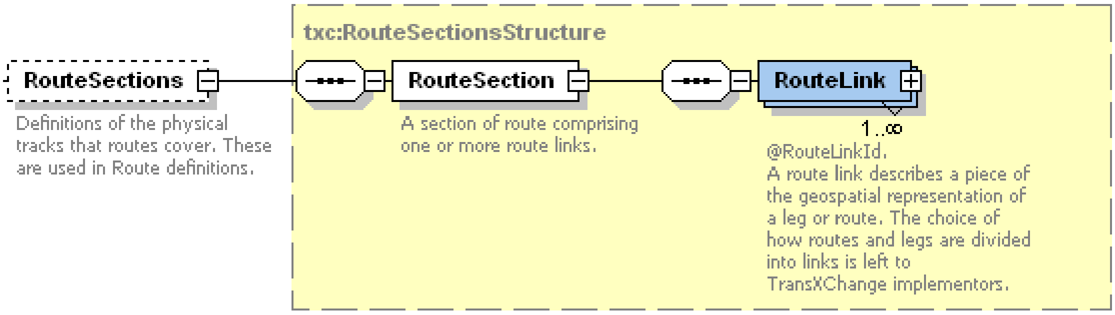

txc:RouteSectionsStructure
RouteSections
Definitions of the physical tracks that routes cover. These are used in Route definitions.
RouteSection
A section of route comprising one or more route links.
RouteLink
1..∞
@RouteLinkId.
A route link describes a piece of the geospatial representation of a leg or route. The choice of how routes and legs are divided into links is left to TransXChange implementors.

Figure 6-7 – RouteSection Element

6.4.3 RouteLink Element

A ***RouteLink*** (*Figure 6-8*) describes the course of a route between two *NaPTAN* stops. It is identified by a unique ***id*** attribute, and comprises:

- ***From***: The ***StopPointRef*** to the stop at which the link starts.
- ***To***: The ***StopPointRef*** to the stop at which the link ends.
- ***Distance***: The length of the path along the route in meters.
- ***Direction***: Direction of the ***Route*** running over the ***RouteLink***. See *Table 6-1*.

Value	Description
inbound	Inbound Direction.
outbound	Outbound Direction.
clockwise	Clockwise Direction.
antiClockwise	Anti-Clockwise Direction.

Table 6-1 – Allowed Values for Link / Direction

- ***Track***: A description of the path of the link as one or more ***Track*** elements.

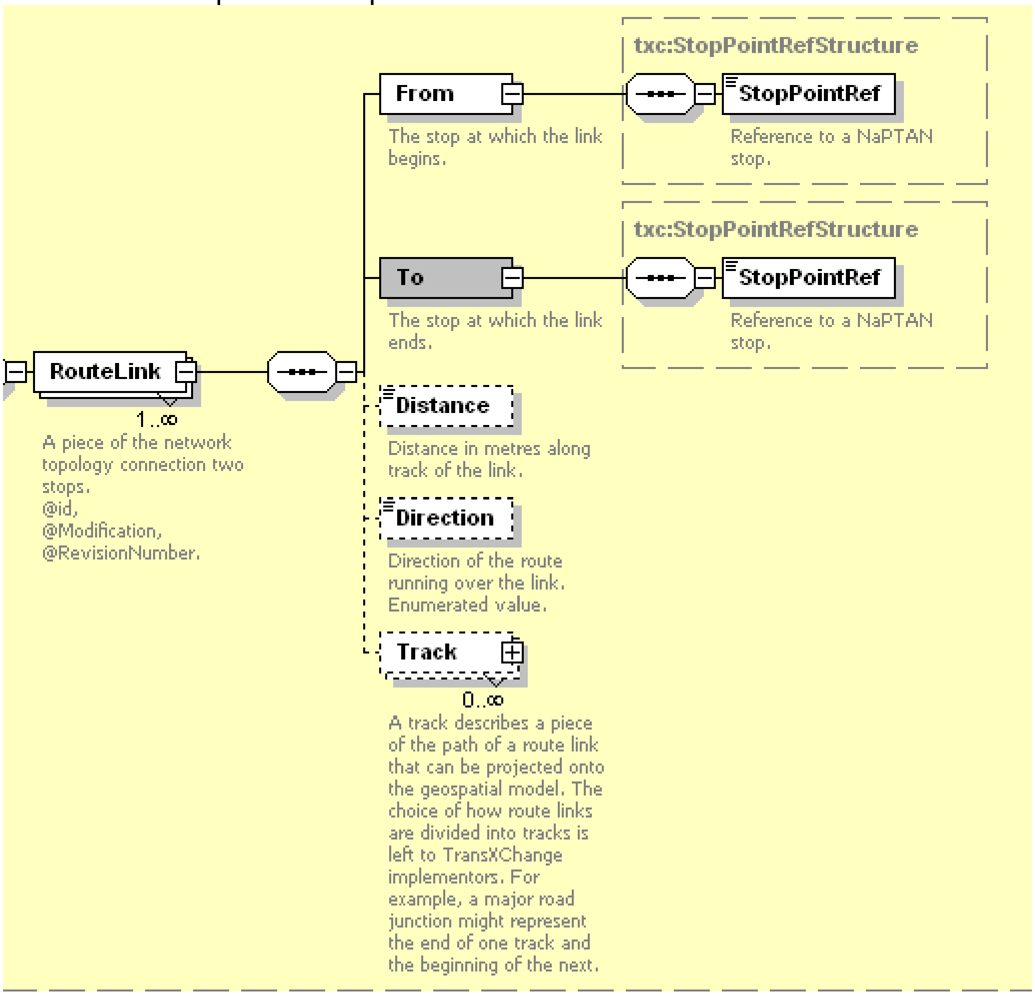

txc:StopPointRefStructure
From
StopPointRef
The stop at which the link begins.
Reference to a NaPTAN stop.
txc:StopPointRefStructure
To
StopPointRef
The stop at which the link ends.
Reference to a NaPTAN stop.
RouteLink
1..∞
A piece of the network topology connection two stops.
@id,
@Modification,
@RevisionNumber.
Distance
Distance in metres along track of the link.
Direction
Direction of the route running over the link. Enumerated value.
Track
0..∞
A track describes a piece of the path of a route link that can be projected onto the geospatial model. The choice of how route links are divided into tracks is left to TransXChange implementors. For example, a major road junction might represent the end of one track and the beginning of the next.

Figure 6-8 – RouteLink Element

6.4.4 Track Element

A ***Track*** element (*Figure 6-9*) describes the path of a route link between *NaPTAN* stops, and optionally, intermediate junction points. It comprises:

- ***Mapping***: A description of the path of the route as a series of geospatial points.
- ***MapSystemReference***: An optional reference to an Ordnance Service TOID or other map feature identifier, using the mapping data system specified by the **MappingSystem** attribute.
- ***Instructions***: Optional detailed step-by-step text instructions for navigating the track.

It is up to the implementor to choose the granularity of tracks – a give route might be represented by none, one, several or many tracks. Typically a track will be used for each distinct road or mapping layer feature that the implementor wishes to associate with part of the route.

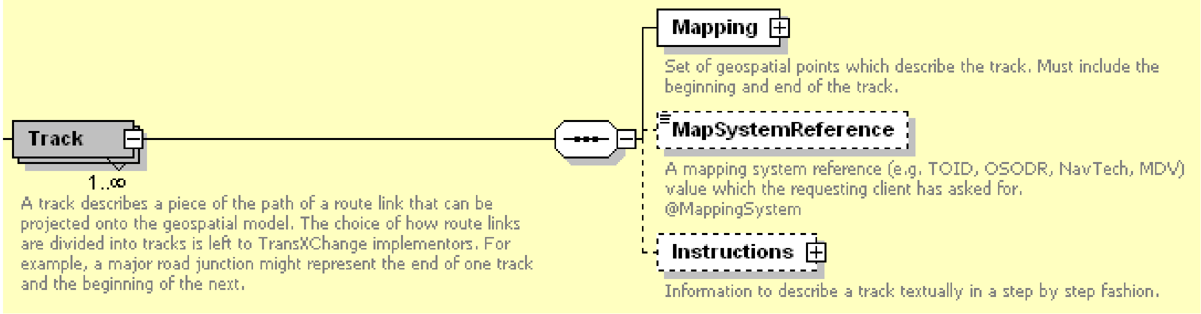

Track
1..∞
A track describes a piece of the path of a route link that can be projected onto the geospatial model. The choice of how route links are divided into tracks is left to TransXChange implementors. For example, a major road junction might represent the end of one track and the beginning of the next.
Mapping
Set of geospatial points which describe the track. Must include the beginning and end of the track.
MapSystemReference
A mapping system reference (e.g. TOID, OSODR, NavTech, MDV) value which the requesting client has asked for.
@MappingSystem
Instructions
Information to describe a track textually in a step by step fashion.

Figure 6-9 – Track Element

6.4.5 Track Subelements

6.4.5.1 Track / Mapping Element

A ***Mapping*** element (*Figure 6-10*) describes the spatial path of a route link between *NaPTAN* stops that can be plotted on a map, as a series of at least two geospatial points: These points are independent of the stop point coordinates (though end points may reference the same coordinate) I.e. to plot a route the last and first point of each successive mapping will be connected.

- ***Location***: A point in either WGS84 or grid coordinates. See Common Schema Elements later.

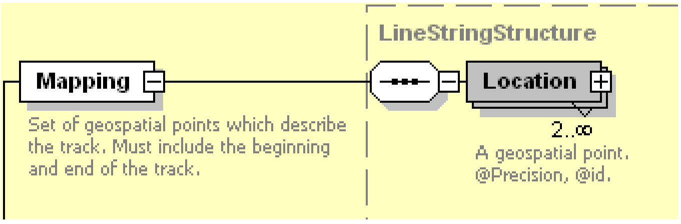

LineStringStructure
Mapping
Set of geospatial points which describe the track. Must include the beginning and end of the track.
Location
2..∞
A geospatial point.
@Precision, @id.

Figure 6-10 – Mapping Element

6.4.5.2 Track / Instructions Element

The ***Instructions*** element (*Figure 6-11*) provides an additional description of the path of a step of a route between *NaPTAN* stops as text instructions, and an ordered collection of structured elements:

- ***Summary***: A free text description of the path of the route.
- ***Feature***: A structured description of one or more steps of the journey.

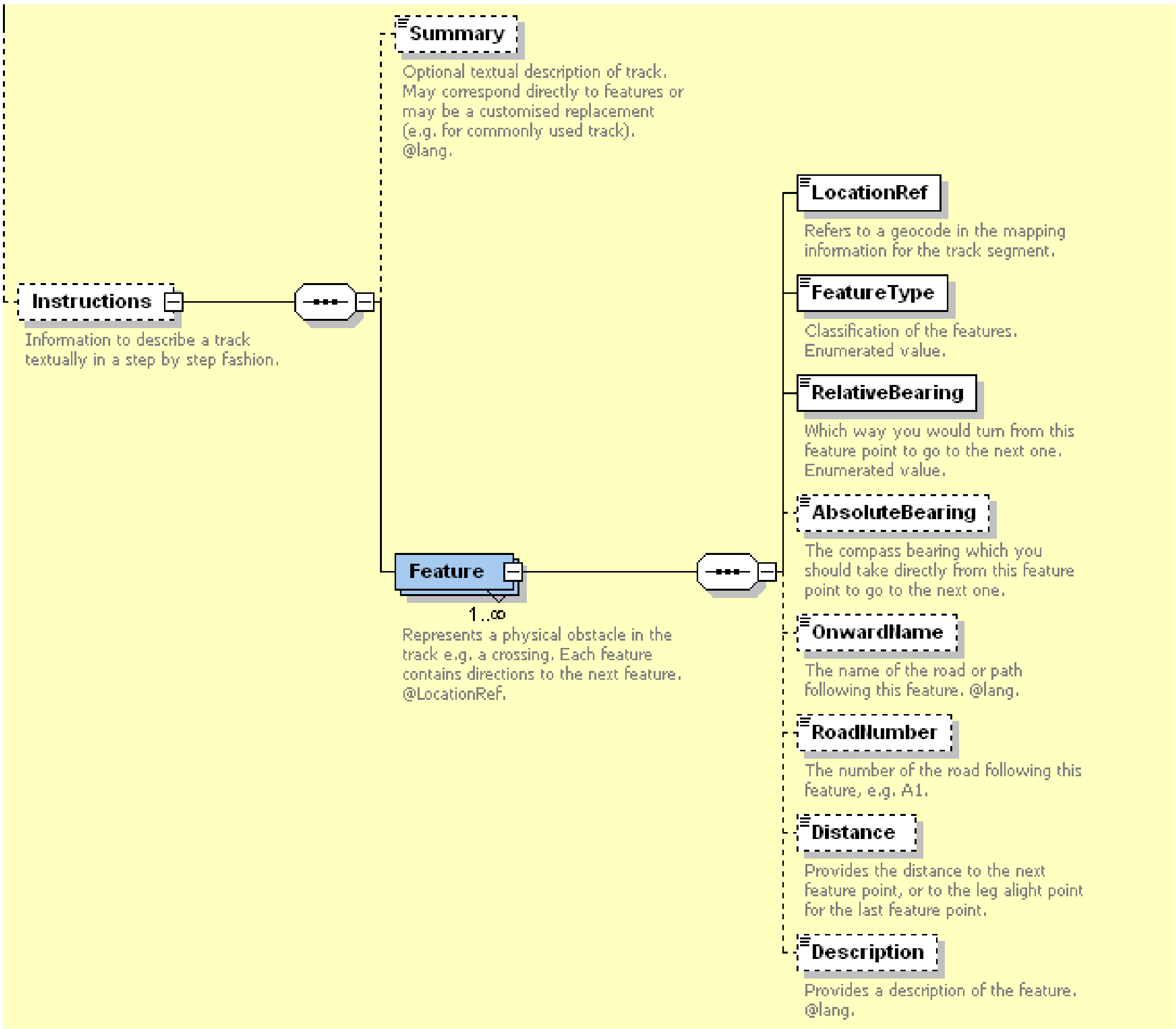

Summary
Optional textual description of track. May correspond directly to features or may be a customised replacement (e.g. for commonly used track). @lang.
Instructions
Information to describe a track textually in a step by step fashion.
Feature
1..∞
Represents a physical obstacle in the track e.g. a crossing. Each feature contains directions to the next feature. @LocationRef.
LocationRef
Refers to a geocode in the mapping information for the track segment.
FeatureType
Classification of the features. Enumerated value.
RelativeBearing
Which way you would turn from this feature point to go to the next one. Enumerated value.
AbsoluteBearing
The compass bearing which you should take directly from this feature point to go to the next one.
OnwardName
The name of the road or path following this feature. @lang.
RoadNumber
The number of the road following this feature, e.g. A1.
Distance
Provides the distance to the next feature point, or to the leg alight point for the last feature point.
Description
Provides a description of the feature. @lang.

Figure 6-11 – Instructions Element

6.4.5.3 Track / Instructions / Feature Element

The ***Feature*** element (*Figure 6-11*) describes a step of a route between *NaPTAN* stops:

- ***LocationRef***: Reference to a ***Location*** in the ***Track's Mapping*** instance that locates the feature on a map.
- ***FeatureType***: Describes the type of feature encountered see Table 6-2*.*

Value	Description
legOrigin	The start point of the leg.
legDestination	The end point of the leg.
bend	A bend in the track that merits attention (without a junction).
crossing	Cross over the road.
bridge	Traversing over a bridge.
junction	Either a point at which another road is taken, or a side road that is passed along the way.
miniRoundabout	Going round a small roundabout.
roadChange	Denotes a change of road name when there is no junction.
roundabout	Going round a small roundabout.
subway	Going through a subway.
trafficLights	Going through traffic lights.
landmark	A named landmark that can be seen from the track. The name should be provided in the Feature Description.

Table 6-2 – Allowed Values for FeatureType

- ***RelativeBearing:*** Which way you would turn from this feature to go to the next one. See *Table 6-3.*

Value	Description
left	Left
right	Right
straightAhead	Straight ahead
uTurn	U-turn

Table 6-3 – Allowed Values for RelativeBearing

- ***AbsoluteBearing:*** The compass bearing which you should take directly from this feature point to go to the next one.
- ***OnwardName***: The name of the road or path following this feature
- ***RoadNumber***: The number of the road following this feature, e.g. ‘A1’.
- ***Distance***: The distance to the next feature point, or to the leg alight point for the last feature point.
- ***Description***: A text description of the individual feature.

6.5 Registration Elements: Operator, Registration, ShortNoticeRegistration

6.5.1 Operators Element

The ***Operators*** element (*Figure 6-12*) contains instances of the two different kinds of operator element that may be referenced by a ***Service:***

- ***Operator:*** An operator definition allowing partial definition of an operator.
- ***LicensedOperator:*** A full definition of an operator as is required for a registration.

The ***Operator*** and ***LicensedOperator*** elements differ only as which of their child elements are required or optional.

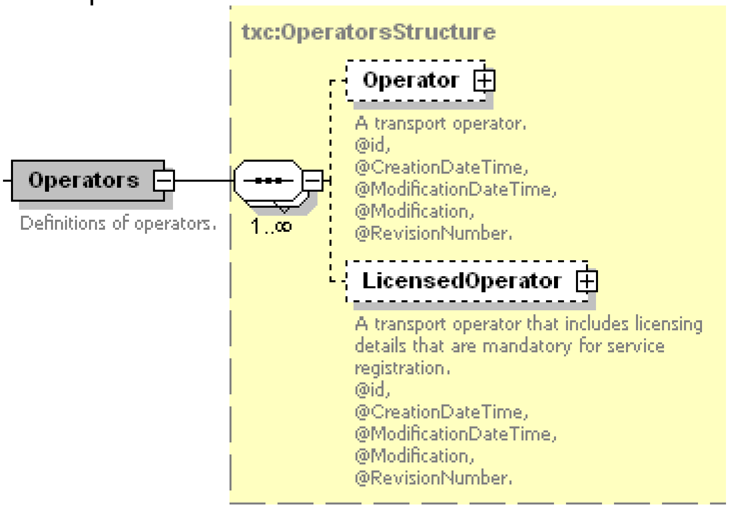


Figure 6-12 – Operators Element

6.5.2 Operator Element

The ***Operator*** element (*Figure 6-13*) describes the ***Operator*** of a service. Every operator has an **id** attribute. References to operators within the document are made through the **id** (rather than the ***OperatorCode*** or the ***NationalOperatorCode),*** in order to guarantee a unique reference. ***Operator*** comprises:

- ***NationalOperatorCode:*** Unique national identifier of operator. This element is to support a future planned national operator code.
- ***OperatorCode:*** Unique Identifier of operator within document.
- ***OperatorShortName:*** Short text name for operator.
- ***OperatorNameOnLicence:*** Full name of the operator, as it appears on licence.
- ***TradingName:*** The name under which operator trades.
- ***LicenceNumber:*** Operator's licence number.
- ***LicenceClassification***: Type of licence that the operator has. See *Table 6-4*.

Value	Description
standardNational	Standard National Licence type.
standardInternational	Standard International Licence type.
restricted	Restricted Licence type.
specialRestricted	Special Restricted Licence type.
communityBusPermit	Community Bus Permit Licence type.

Table 6-4 – Allowed Values for LicenceClassification

- ***OperatorContactGroup:*** Information about how to contact the operator. See ***OperatorContactGroup*** below.
- ***Garages:*** The garages which the operator runs. See below.

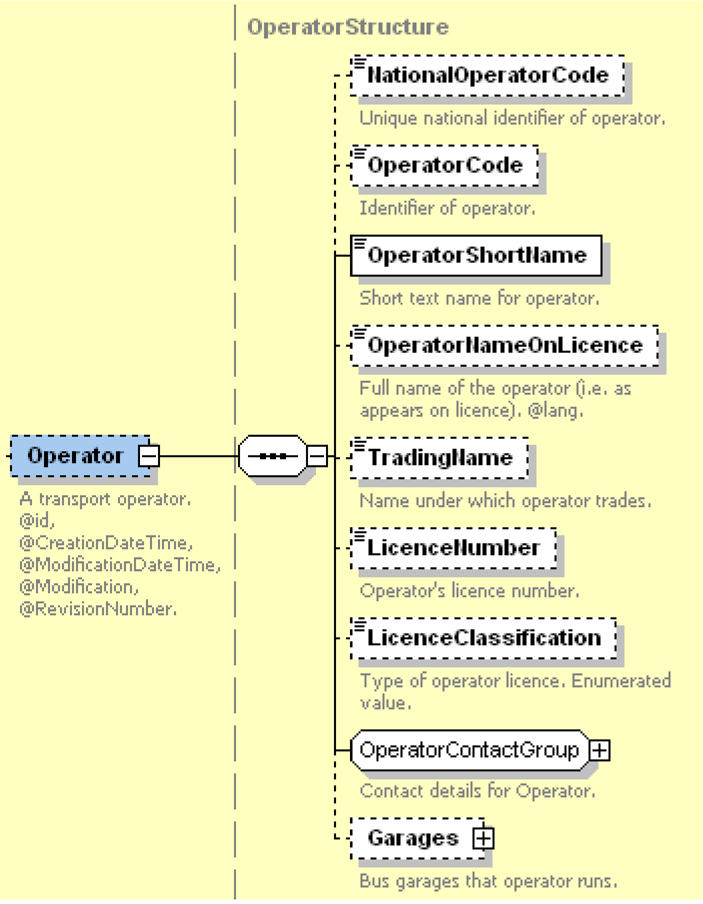

OperatorStructure
Operator
A transport operator. @id, @CreationDateTime, @ModificationDateTime, @Modification, @RevisionNumber.
NationalOperatorCode
Unique national identifier of operator.
OperatorCode
Identifier of operator.
OperatorShortName
Short text name for operator.
OperatorNameOnLicence
Full name of the operator (i.e. as appears on licence). @lang.
TradingName
Name under which operator trades.
LicenceNumber
Operator's licence number.
LicenceClassification
Type of operator licence. Enumerated value.
OperatorContactGroup
Contact details for Operator.
Garages
Bus garages that operator runs.

Figure 6-13 – Operator Element

6.5.3 LicensedOperator Element

The ***LicensedOperator*** element (*Figure 6-13*) is identical to the ***Operator*** element except that certain fields are mandatory.

- ***OperatorNameOnLicence, LicenceNumber, LicenceClassification***.
- ***LicensedOperatorContactGroup: ContactTelephoneNumber, EnquiryTelephoneNumber, OperatorAddresses***.

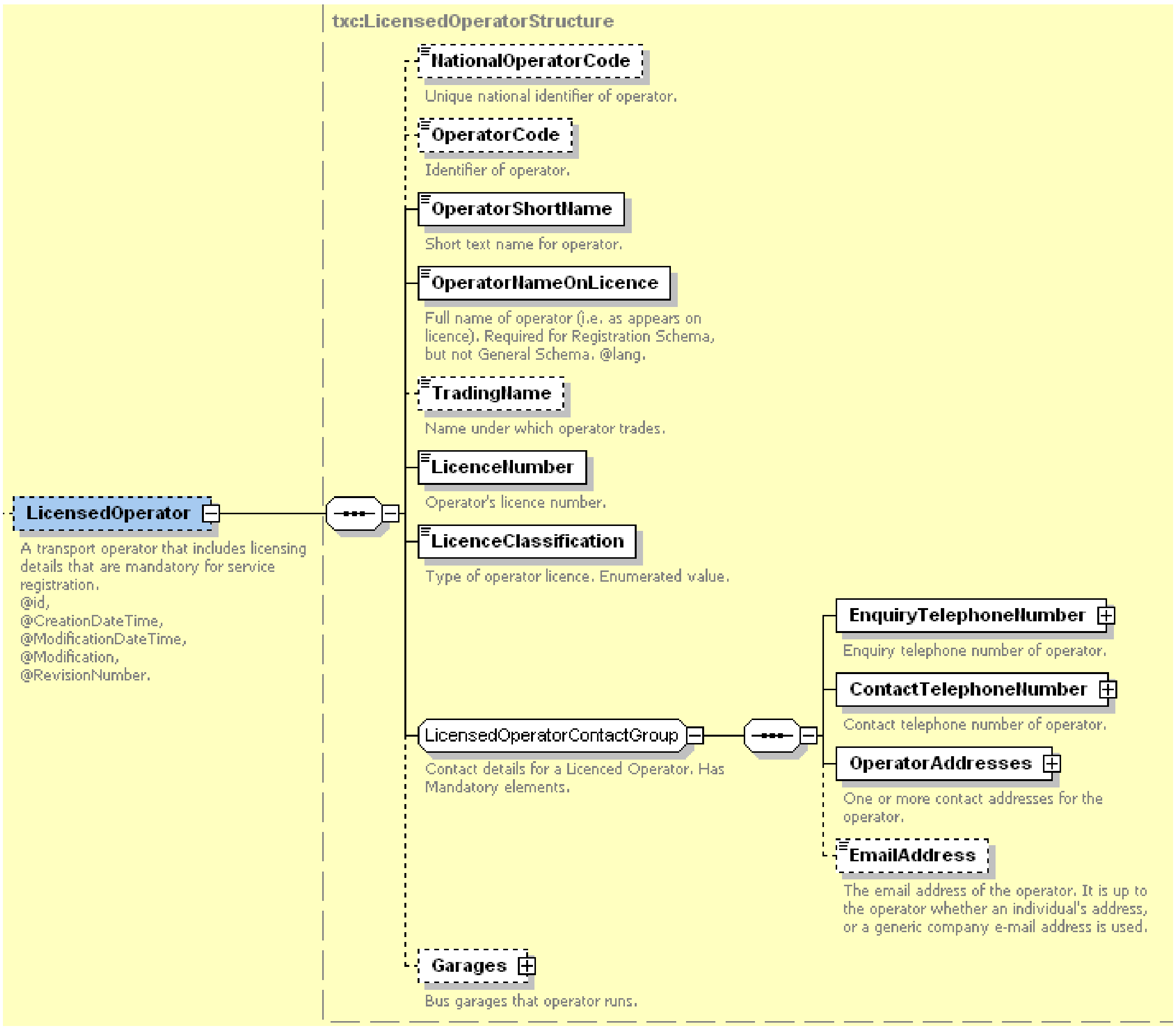

txc:LicensedOperatorStructure
NationalOperatorCode
Unique national identifier of operator.
OperatorCode
Identifier of operator.
OperatorShortName
Short text name for operator.
OperatorNameOnLicence
Full name of operator (i.e. as appears on licence). Required for Registration Schema, but not General Schema. @lang.
TradingName
Name under which operator trades.
LicenceNumber
Operator's licence number.
LicenceClassification
Type of operator licence. Enumerated value.
LicensedOperator
A transport operator that includes licensing details that are mandatory for service registration. @id, @CreationDateTime, @ModificationDateTime, @Modification, @RevisionNumber.
EnquiryTelephoneNumber
Enquiry telephone number of operator.
ContactTelephoneNumber
Contact telephone number of operator.
LicensedOperatorContactGroup
Contact details for a Licenced Operator. Has Mandatory elements.
OperatorAddresses
One or more contact addresses for the operator.
EmailAddress
The email address of the operator. It is up to the operator whether an individual's address, or a generic company e-mail address is used.
Garages
Bus garages that operator runs.

Figure 6-14 – LicensedOperator Element

6.5.4 Operator & LicensedOperator: Subelements

6.5.4.1 OperatorContactGroup

The ***OperatorContactGroup*** (*Figure 6-15*) describes the contact details for an ***Operator*** of a service and comprises:

- ***EnquiryTelephoneNumber:*** Telephone Number for public enquiries to the operator concerning the service. See ***TelephoneContactStructure*** in common schema elements in *Section 7*.
- ***ContactTelephoneNumber:*** Telephone Number to contact operator concerning the service. See ***TelephoneContactStructure*** below.
- ***OperatorAddresses:*** Operator's addresses. A separate ***OperatorAddress*** and ***CorrespondanceAddress*** can be specified. See ***PostalAddressStructure*** in Common Schema Elements in *Section 7*.
- ***EmailAddress:*** The email address of the operator. It is up to the operator whether an individual's address or a generic company e-mail address is used.

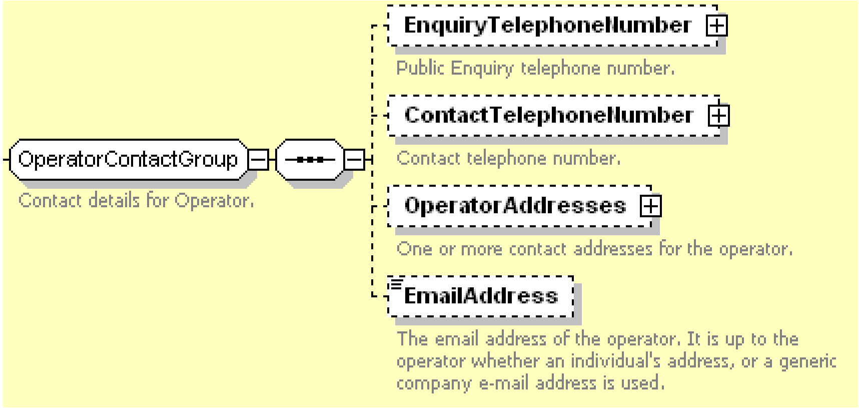

EnquiryTelephoneNumber
Public Enquiry telephone number.
ContactTelephoneNumber
Contact telephone number.
OperatorContactGroup
Contact details for Operator.
OperatorAddresses
One or more contact addresses for the operator.
EmailAddress
The email address of the operator. It is up to the operator whether an individual's address, or a generic company e-mail address is used.

Figure 6-15 – Operator / OperatorContactGroup

6.5.4.2 Operator / Garages Element

The ***Operator / Garages*** element records details about the garages or depots which the operator uses. It contains a collection of ***Garage*** (*Figure 6-16*) elements.
Each ***Garage*** is composed of:

- ***GarageCode***: Identifier of garage. This will be referenced by other elements.
- ***GarageName***: Name of garage.
- ***ContactNumber:*** Telephone Number to contact for queries about operational data. See ***TelephoneContactStructure*** in Common Schema Elements in *Section 7*.
- ***Address***: Postal Address of garage. See ***PostalAddressStructure*** in Common Schema Elements in *Section 7*.
- ***Location***: Spatial coordinates of garage.

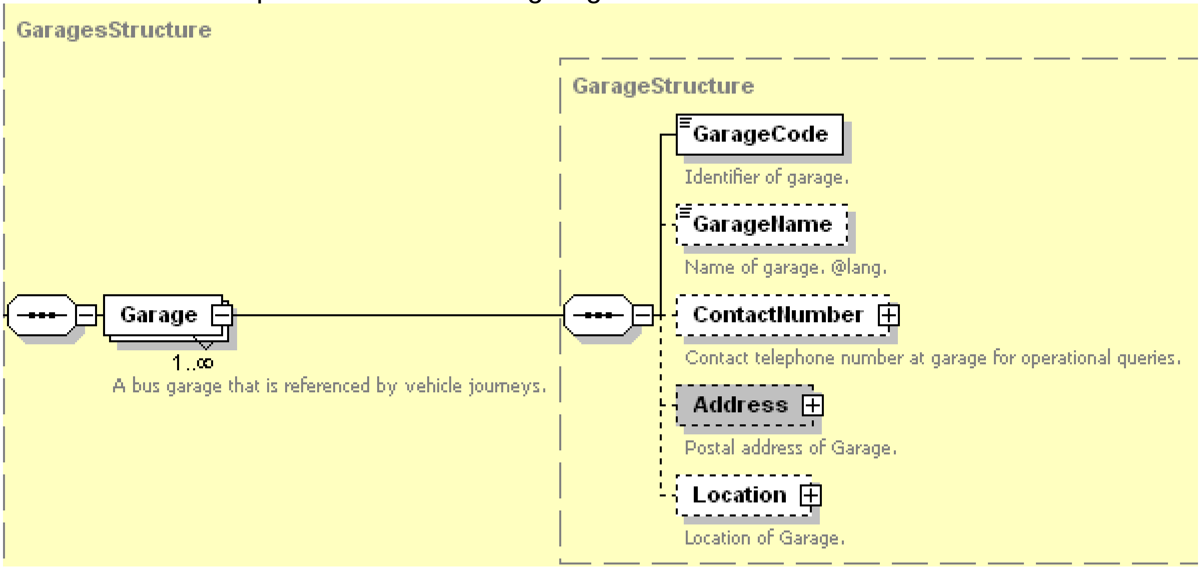


Figure 6-16 – Operator / Garages / Garage Element

6.5.5 Registration Element

The ***Registration*** element (*Figure 6-17*) records statutory administrative details about the registration of the service. In the *TransXChange Registration Schema* the element is mandatory; in the *TransXChange General Schema* it is not. A ***Registration*** comprises:

- ***ServiceRef***: The ***Service*** that the registration covers.
- ***RegistrationSubmissionGroup***: Describes basic properties of registration.
- ***RegistrationInfoGroup***: Describes further properties of the registration.

- ***ShortNoticeRegistration:*** Additional information to support a registration made with less than the statutory period of notice. See later below.

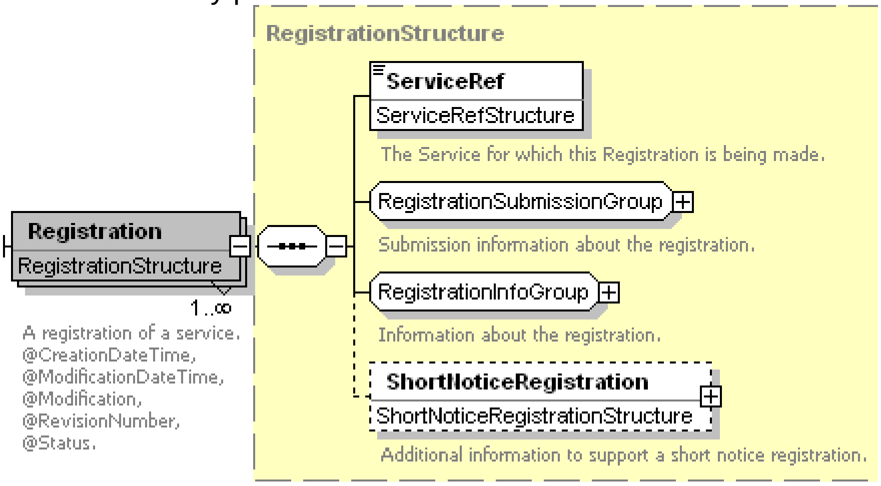

RegistrationStructure
ServiceRef
ServiceRefStructure
The Service for which this Registration is being made.
RegistrationSubmissionGroup
Submission information about the registration.
RegistrationInfoGroup
Information about the registration.
ShortNoticeRegistration
ShortNoticeRegistrationStructure
Additional information to support a short notice registration.
Registration
RegistrationStructure
1..∞
A registration of a service.
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber,
@Status.

Figure 6-17 – Registration Element

6.5.6 RegistrationSubmissionGroup

The ***RegistrationSubmissionGroup*** (*Figure 6-18*) holds elements describing the basic submission of registration.

- ***SubmissionDate***: Intended date of ***Registration*** submission by submitter (officially received date may be different).
- ***VosaRegistrationNumber***: The identifiers for the ***Registration***. See below.
- ***ApplicationClassification***: Type of the registration application. See *Table 6-5.*

Value	Description
new	New registration.
chargeableChange	Chargeable modification of an existing registration.
nonChargeableChange	Non-chargeable modification of an existing registration.
cancel	Cancellation of a registration.

Table 6-5 – Allowed Values for Registration / ApplicationClassification

- ***VariationNumber***: Variation number of the registration.
- ***SubmissionAuthor***: Contact details of person submitting registration. See below.
- ***TrafficAreas:*** A collection of ***TrafficArea*** instances with full or partial responsibility for the registration of the submission. See below.
- ***CirculatedAuthorities:*** Collection of ***CirculatedAuthority*** instances to whom the registration is to be circulated. See below.

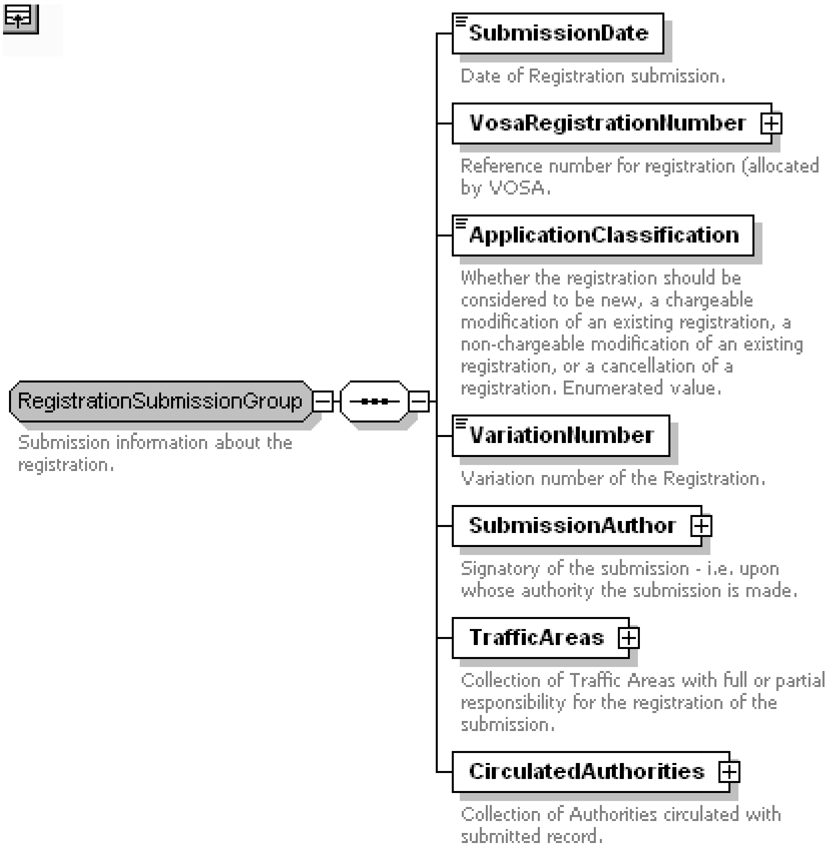

SubmissionDate
Date of Registration submission.
VosaRegistrationNumber
Reference number for registration (allocated by VOSA.
ApplicationClassification
Whether the registration should be considered to be new, a chargeable modification of an existing registration, a non-chargeable modification of an existing registration, or a cancellation of a registration. Enumerated value.
RegistrationSubmissionGroup
Submission information about the registration.
VariationNumber
Variation number of the Registration.
SubmissionAuthor
Signatory of the submission - i.e. upon whose authority the submission is made.
TrafficAreas
Collection of Traffic Areas with full or partial responsibility for the registration of the submission.
CirculatedAuthorities
Collection of Authorities circulated with submitted record.

Figure 6-18 – RegistrationSubmissionGroup

6.5.7 RegistrationInfoGroup

The ***RegistrationInfoGroup*** (*Figure 6-19*) holds elements describing additional properties of a registration.

- ***SubsidyDetails:*** Information about any subsidy of the ***Service***. See below.
- ***ContractedService:*** Information about any contract under which the ***Service*** is run for an authority. See below.
- ***QualityPartnership:*** Information about any Statutory Quality partnership under which the ***Service*** is run.
- ***SupportingDocuments:*** Names of additional documents that accompany the registration. Note that references to any schematic maps that are in image format should be placed with the ***Service*** / ***SchematicMap*** element, and not here.

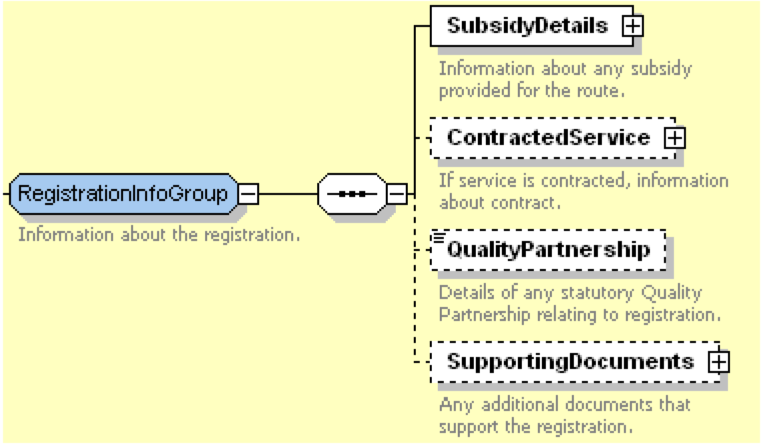

RegistrationInfoGroup
Information about the registration.
SubsidyDetails
Information about any subsidy provided for the route.
ContractedService
If service is contracted, information about contract.
QualityPartnership
Details of any statutory Quality Partnership relating to registration.
SupportingDocuments
Any additional documents that support the registration.

Figure 6-19 – RegistrationInfoGroup

6.5.8 Registration Subelements

6.5.8.1 Registration / VosaRegistrationNumber Element

The ***VosaRegistrationNumber*** element (*Figure 6-20*) specifies the unique identifiers of the ***Registration***. It is made up of three components:

- ***TanCode:*** Two character Traffic Area prefix. See *Table 6-6.*

Value	Description
PB	North Eastern Traffic Area
PC	North Western Traffic Area
PD	West Midlands Traffic Area
PF	Eastern Traffic Area
PG	Welsh Traffic Area
PH	Western Traffic Area
PK	South Eastern and Metropolitan Traffic Area
PM	Scottish Traffic Area

Table 6-6 – Allowed Values for TanCode

- ***LicenceNumber:*** The Registered operator’s seven character licence number. This should be the same as the ***Operator / LicenceNumber*** value.
- ***RegistrationNumber***: Unique identifier of registration for licence holder. 1-4 numeric only characters.

When displayed, numbers include a separator slash between the licence number and the suffix, for example ‘PB1235601/456’.

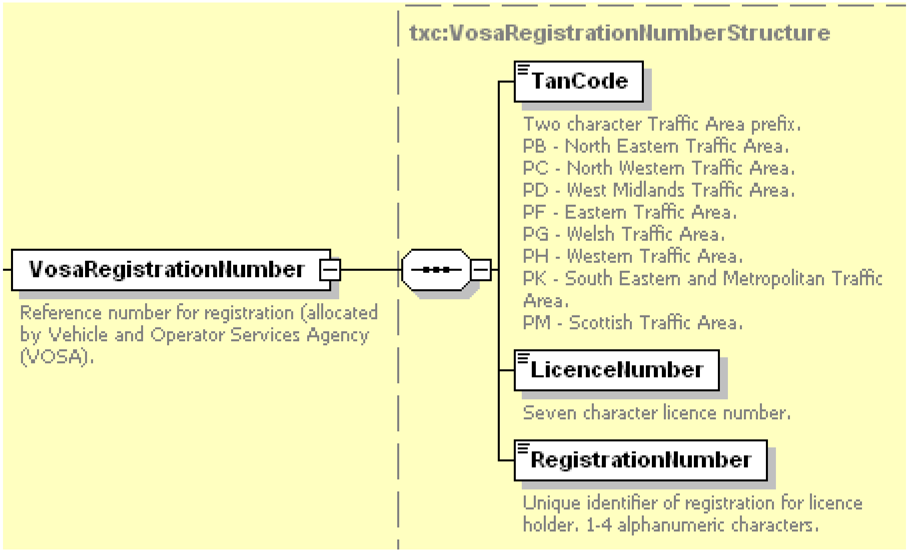

txc:VosaRegistrationNumberStructure
TanCode
Two character Traffic Area prefix.
PB - North Eastern Traffic Area.
PC - North Western Traffic Area.
PD - West Midlands Traffic Area.
PF - Eastern Traffic Area.
PG - Welsh Traffic Area.
PH - Western Traffic Area.
PK - South Eastern and Metropolitan Traffic Area.
PM - Scottish Traffic Area.
VosaRegistrationNumber
Reference number for registration (allocated by Vehicle and Operator Services Agency (VOSA).
LicenceNumber
Seven character licence number.
RegistrationNumber
Unique identifier of registration for licence holder. 1-4 alphanumeric characters.

Figure 6-20 – Registration / VosaRegistrationNumber Element

6.5.8.2 Registration / SubmissionAuthor Element

The ***SubmissionAuthor*** (*Figure 6-21*) describes the signatory of the submission – that is, upon whose authority the submission is made. It comprises:

- ***Position:*** Position of the signatory of the ***Registration***.
- ***Title:*** Title of the signatory of the ***Registration***.
- ***Forename:*** Forename of the signatory of the ***Registration***.
- ***Surname:*** Surname of the signatory of the ***Registration***.

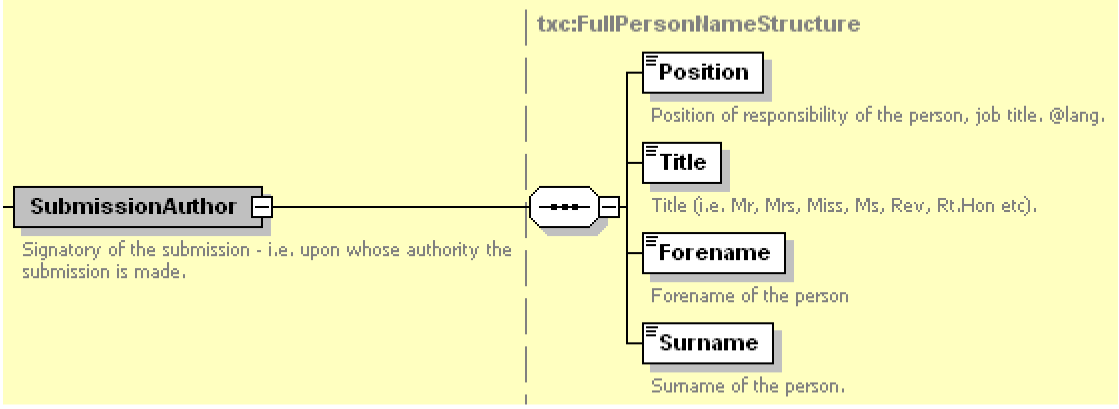

txc:FullPersonNameStructure
Position
Position of responsibility of the person, job title. @lang.
Title
Title (i.e. Mr, Mrs, Miss, Ms, Rev, Rt.Hon etc).
SubmissionAuthor
Signatory of the submission - i.e. upon whose authority the submission is made.
Forename
Forename of the person
Surname
Surname of the person.

Figure 6-21 – Registration / SubmissionAuthor Element

6.5.8.3 Registration / TrafficArea Element

The ***TrafficAreas*** element (*Figure 6-22*) lists the individual ***TrafficArea*** elements for the registration.

- ***TrafficAreaName***: Specifies a TrafficArea – see *Table 6-7*.

Value	Description
Eastern	Eastern.
NorthEastern	North Eastern.
NorthWestern	North Western.
SouthEastMetropolitan	South East Metropolitan.
Scottish	Scottish.
Welsh	Welsh.
WestMidlands	West Midlands.
Western	Western.

Table 6-7 – Allowed Values for TrafficArea / Names

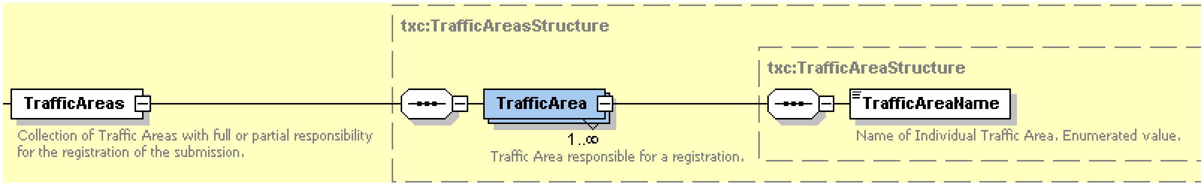

txc:TrafficAreasStructure
TrafficAreas
Collection of Traffic Areas with full or partial responsibility for the registration of the submission.
TrafficArea
1..∞
Traffic Area responsible for a registration.
txc:TrafficAreaStructure
TrafficAreaName
Name of Individual Traffic Area. Enumerated value.

Figure 6-22 – Registration / TrafficArea Element

6.5.8.4 Registration / CirculatedAuthorities Element

The ***CirculatedAuthorities*** element (*Figure 6-23*) lists the individual ***CirculatedAuthority*** elements for the registration.

- ***CirculatedAuthority:*** Names identifying circulated authority. See *Table 6-8*.

Value	English	Welsh
Aberdeen	Aberdeen	
Aberdeenshire	Aberdeenshire	
Angus	Angus	
ArgyllAndBute	Argyll and Bute	
BathAndNorthEastSomerset	Bath and North East Somerset	
Bedfordshire	Bedfordshire	
Berkshire	Berkshire	
BlackburnWithDarwen	Blackburn with Darwen	
Blackpool	Blackpool	
BlaenauGwent	Blaenau Gwent	
Bournemouth	Bournemouth	
BracknellForest	Bracknell Forest	
Bridgend	Bridgend	
BrightonAndHove	Brighton and Hove	
Bristol	Bristol	
Buckinghamshire	Buckinghamshire	
Caerphilly	Caerphilly	
Cambridgeshire	Cambridgeshire	
Cardiff	Cardiff	
Carmarthenshire	Carmarthenshire	
CentroWestMidlands	Centro (West Midlands)	
Ceredigion	Ceredigion	
ChannelIslands	Channel Islands	
Cheshire	Cheshire	
Clackmannanshire	Clackmannanshire	
ComhairleNanEileanSiar	Comhairle Nan Eilean Siar	
Conwy	Conwy	
CornwallAndSclillies	Cornwall and Scillies	
Cumbria	Cumbria	
Darlington	Darlington	
Denbighshire	Denbighshire	

Derby	Derby	
Derbyshire	Derbyshire	
Devon	Devon	
Dorset	Dorset	
DumfriesAndGalloway	Dumfries and Galloway	
Dundee	Dundee	
Durham	Durham	
EastAyrshire	East Ayrshire	
EastDunbartonshire	East Dunbartonshire	
EastLothian	East Lothian	
EastRenfrewshire	East Renfrewshire	
EastRidingOfYorkshire	East Riding of Yorkshire	
EastSussex	East Sussex	
Edinburgh	Edinburgh	
Essex	Essex	
Falkirk	Falkirk	
Fife	Fife	
Flintshire	Flintshire	
Glasgow	Glasgow	
Gloucestershire	Gloucestershire	
GMPTE	GMPTE (Manchester)	
Gwynedd	Gwynedd	
Halton	Halton	
Hampshire	Hampshire	
Hartlepool	Hartlepool	
Havering	Havering	
Herefordshire	Herefordshire	
Hertfordshire	Hertfordshire	
Highland	Highland	
Inverclyde	Inverclyde	
IsleOfAnglesey	Isle of Anglesey	
IsleOfMan	Isle of Man	
IsleOfWight	Isle of Wight	
Kent	Kent	
KingstonUponHull	Kingston Upon Hull	
Lancashire	Lancashire	
Leicester	Leicester	
Leicestershire	Leicestershire	
Lincolnshire	Lincolnshire	
London	London	
Luton	Luton	
Medway	Medway	

Merseytravel	Merseytravel	
MerthyrTydfil	Merthyr Tydfil	
MetroWestYorks	Metro (West Yorks)	
Middlesbrough	Middlesbrough	
Midlothian	Midlothian	
MiltonKeynes	Milton Keynes	
Monmouthshire	Monmouthshire	
Moray	Moray	
NeathPortTalbot	Neath Port Talbot	
WestBerkshire	West Berkshire	
Newport	Newport	
NexusTyneside	Nexus (Tyneside)	
Norfolk	Norfolk	
NorthAyrshire	North Ayrshire	
NorthEastLincolnshire	North East Lincolnshire	
NorthernIreland	Northern Ireland	
NorthLanarkshire	North Lanarkshire	
NorthLincolnshire	North Lincolnshire	
NorthSomerset	North Somerset	
NorthYorkshire	North Yorkshire	
Northamptonshire	Northamptonshire	
Northumberland	Northumberland	
Nottingham	Nottingham	
Nottinghamshire	Nottinghamshire	
OrkneyIslands	Orkney Islands	
Oxfordshire	Oxfordshire	
Pembrokeshire	Pembrokeshire	
PerthAndKinross	Perth and Kinross	
Peterborough	Peterborough	
Plymouth	Plymouth	
Poole	Poole	
Portsmouth	Portsmouth	
Powys	Powys	
Reading	Reading	
RedcarAndCleveland	Redcar and Cleveland	
Renfrewshire	Renfrewshire	
RhonddaCynonTaff	Rhondda Cynon Taff	
Rutland	Rutland	
ScottishBorders	Scottish Borders	
ShetlandIslands	Shetland Islands	
Shropshire	Shropshire	
Slough	Slough	

Somerset	Somerset	
SouthAyrshire	South Ayrshire	
SouthGloucestershire	South Gloucestershire	
SouthLanarkshire	South Lanarkshire	
SouthYorkshirePTE	South Yorkshire PTE	
Southampton	Southampton	
SouthendOnSea	Southend On Sea	
Staffordshire	Staffordshire	
Stirling	Stirling	
StocktonOnTees	Stockton On Tees	
StokeOnTrent	Stoke On Trent	
StrathclydePTE	Strathclyde PTE	
Suffolk	Suffolk	
Surrey	Surrey	
Swansea	Swansea	
Swindon	Swindon	
TelfordAndWrekin	Telford and Wrekin	
Thurrock	Thurrock	
Torbay	Torbay	
Torfaen	Torfaen	
ValeOfGlamorgan	Vale of Glamorgan	
Warrington	Warrington	
Warwickshire	Warwickshire	
WestDunbartonshire	West Dunbartonshire	
WestLothian	West Lothian	
WestSussex	West Sussex	
Wiltshire	Wiltshire	
WindsorAndMaidenhead	Windsor and Maidenhead	
Wokingham	Wokingham	
Worcestershire	Worcestershire	
York	York	

Table 6-8 – Allowed Values for CirculatedAuthority Names

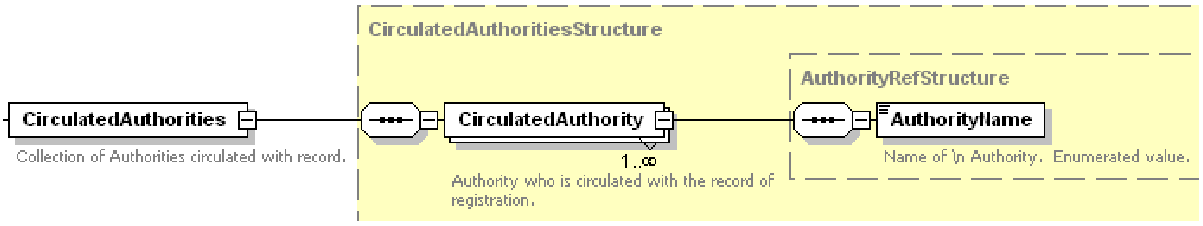

CirculatedAuthoritiesStructure
AuthorityRefStructure
CirculatedAuthorities
Collection of Authorities circulated with record.
CirculatedAuthority
1..∞
Authority who is circulated with the record of registration.
AuthorityName
Name of \n Authority. Enumerated value.

Figure 6-23 – Registration / CirculatedAuthorities Element

6.5.8.5 Registration / SubsidyDetails Element

The ***SubsidyDetails*** element (*Figure 6-24*) gives information about any subsidy that applies to the ***Registration***.
Either there are none – ***NoSubsidy***, or there is a ***Subsidy,*** made up of two elements:

- ***SubsidyType:*** Whether subsidy is full or partial. *Table 6-9*.

Value	Description
partial	Partial subsidy applies.
full	Full subsidy applies.

Table 6-9 – Allowed Values for SubsidyType

- ***SubsidisingAuthority:*** Name of subsidising authority.

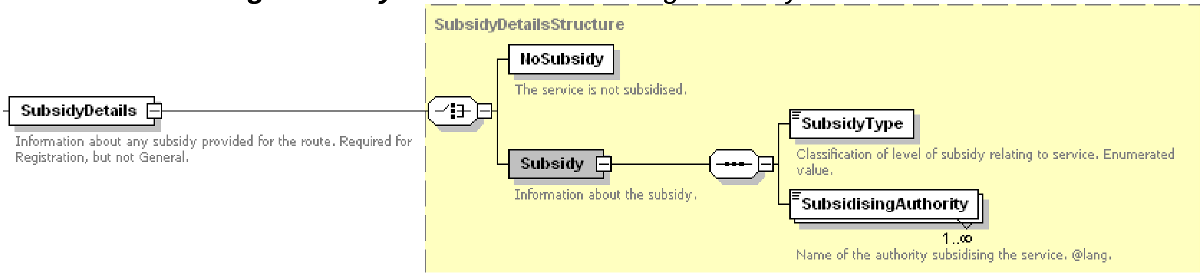

SubsidyDetailsStructure
NoSubsidy
The service is not subsidised.
SubsidyDetails
Information about any subsidy provided for the route. Required for Registration, but not General.
SubsidyType
Classification of level of subsidy relating to service. Enumerated value.
Subsidy
Information about the subsidy.
SubsidisingAuthority
1..∞
Name of the authority subsidising the service. @lang.

Figure 6-24 – Registration / SubsidyDetails Element

6.5.8.6 Registration / ContractedService Element

The ***ContractedService*** element (*Figure 6-25*) specifies if the service is run under contract to a Local Authority or SPT. This item is specific to Scottish registration.
Nature of Contract:

- ***NotContracted:*** Service is not run under contract.
- ***WhollyContracted:*** Service is run wholly under contract.
- ***PartContracted:*** Service is run in part under contract.
- ***ContractingAuthority:*** Names of one or more authorities awarding contract. See ***CirculatedAuthority / AuthorityName***.

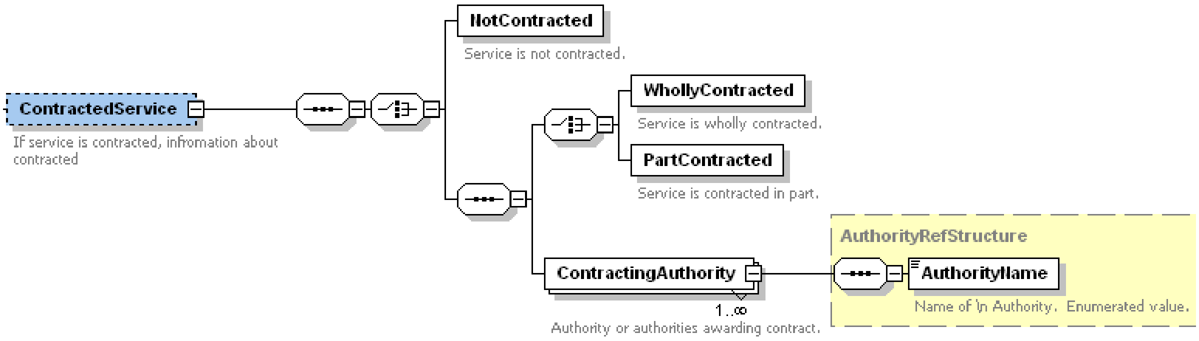

NotContracted
Service is not contracted.
ContractedService
If service is contracted, infromation about contracted
WhollyContracted
Service is wholly contracted.
PartContracted
Service is contracted in part.
AuthorityRefStructure
ContractingAuthority
1..∞
Authority or authorities awarding contract.
AuthorityName
Name of \n Authority. Enumerated value.

Figure 6-25 – Registration / ContractedService Element

6.5.8.7 Registration / SupportingDocument Element

The ***SupportingDocument*** element (*Figure 6-26*) Associates any supporting documents associated with the service. Documents are identified by a ***DocumentUri***.

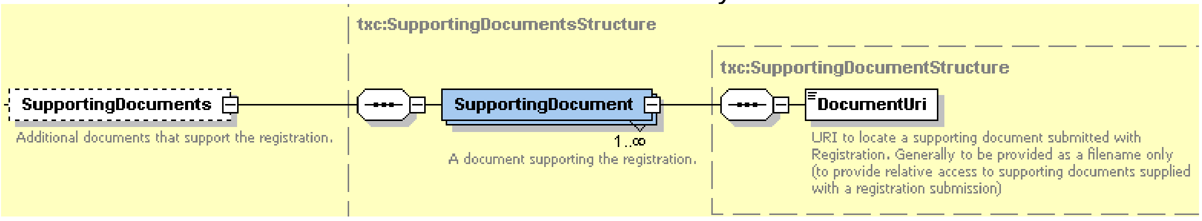

txc:SupportingDocumentsStructure
txc:SupportingDocumentStructure
SupportingDocuments
Additional documents that support the registration.
SupportingDocument
1..∞
A document supporting the registration.
DocumentUri
URI to locate a supporting document submitted with Registration. Generally to be provided as a filename only (to provide relative access to supporting documents supplied with a registration submission)

Figure 6-26 – Registration / SupportingDocument Element

6.5.9 ShortNoticeRegistration Element

A short notice registration is an application to register, cancel or change a service made with less than the normally 56 days' period of notice. Only certain determined cases can be submitted within the reduced period. A ***ShortNoticeRegistration*** requires additional details as specified by one or more elements in the ***ChangeImpactGroup*** & ***ChangeJustification-Group***.

- ***ChangeImpactGroup***: Elements describing the impact of the change.
- ***ChangeJustificationGroup:*** Elements describing the justification(s) for the change.

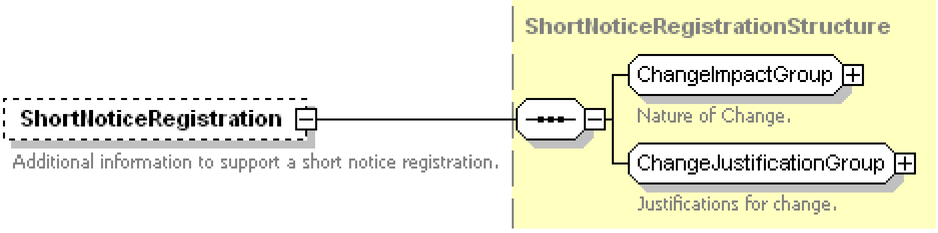

ShortNoticeRegistrationStructure
ShortNoticeRegistration
Additional information to support a short notice registration.
ChangeImpactGroup
Nature of Change.
ChangeJustificationGroup
Justifications for change.

Figure 6-27 – ShortNoticeRegistration Element

6.5.10 ShortNoticeRegistration / ChangeImpactGroup

The ***ChangeImpactGroup*** (*Figure* 6-28) holds elements describing the impact of the change. These include:

- ***PublicAvailability***: Whether the service is to be available to the general public. See below.
- ***ChangeImpact***: Whether the change to the service time is in excess of the normal allowed limits and so requires additional justification. See below.

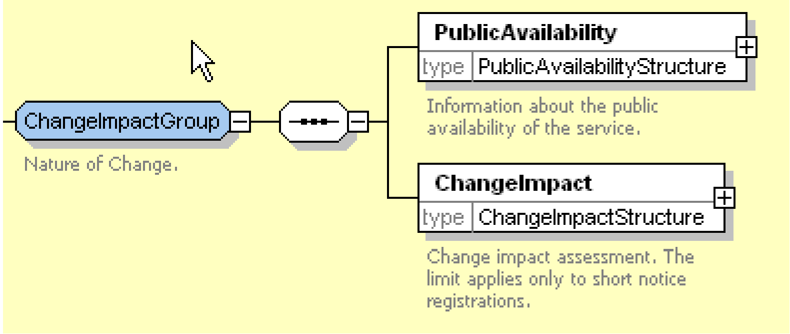

PublicAvailability
type PublicAvailabilityStructure
Information about the public availability of the service.
ChangeImpactGroup
Nature of Change.
ChangeImpact
type ChangeImpactStructure
Change impact assessment. The limit applies only to short notice registrations.

Figure 6-28 – ShortNoticeRegistration / ChangeImpactGroup

6.5.11 ShortNoticeRegistration / ChangeJustificationGroup

The ***ChangeJustificationGroup*** (*Figure 6-29*) holds elements describing the justification(s) for the change. These include:

- ***BankHolidayChange***: Whether the ***ShortNoticeRegistration*** is needed to address a bank holiday requirement. See below.
- ***ChangeToConnectAlteredService***: Whether the short notice registration is needed to handle a modification to another service. See below.
- ***ReplaceDiscontinuedService***: Whether the service is to replace a discontinued service, whose discontinuation justifies the short notice registration? See below.
- ***LocalHolidayChange***: Whether the short notice registration is to accommodate a local holiday. See below.
- ***SpecialOccasion***: Whether the short notice registration is to accommodate a special occasion. See below.

- ***RegulationOrderCompliance***: Whether the short notice registration is needed to meet a road traffic order. See below.
- ***ChangeRequestedByExternalAuthority***: Whether the short notice registration is needed to meet a request by an external authority such as the Police. See below.
- ***ExceptionalRequirement***: Whether the short notice registration is needed to meet an allowed exceptional requirement. See below.
- ***MiscellaneousJustification***: The reasons justifying the short notice registration submission where none of the above considerations are applicable. More than one reason may be included.

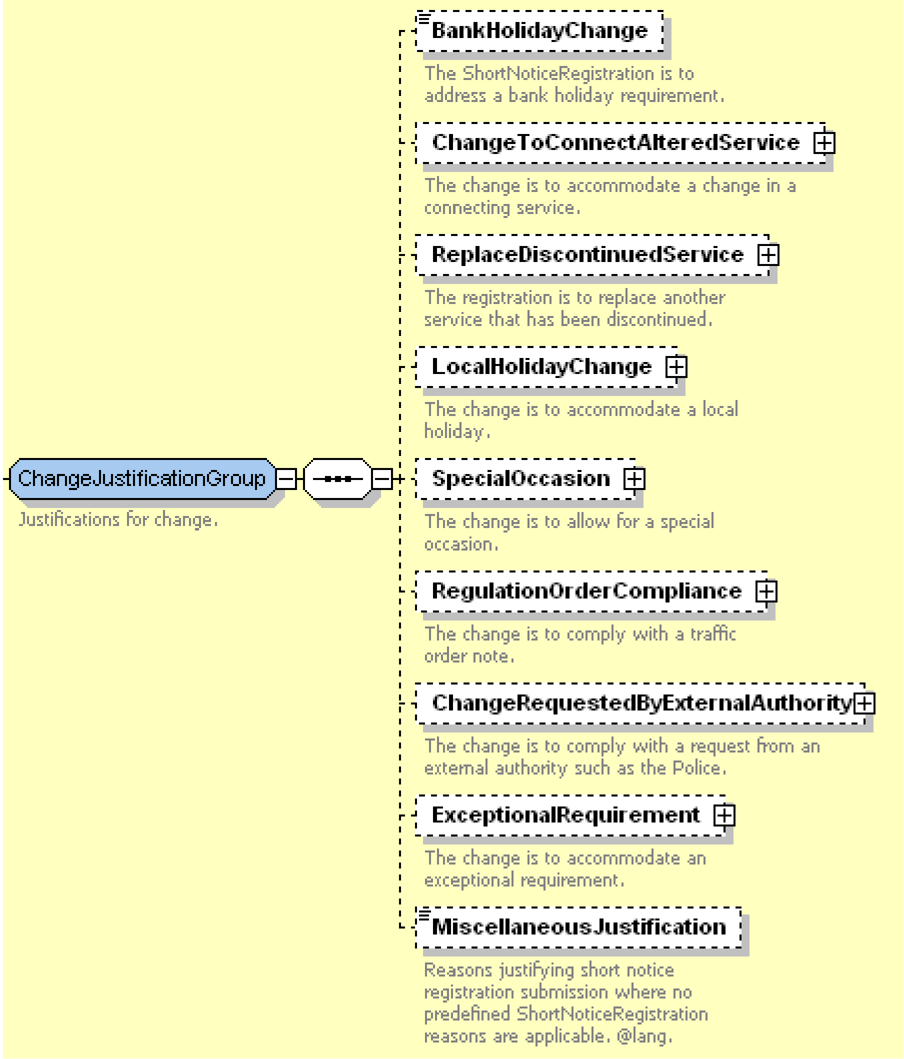

ChangeJustificationGroup
Justifications for change.
BankHolidayChange
The ShortNoticeRegistration is to address a bank holiday requirement.
ChangeToConnectAlteredService
The change is to accommodate a change in a connecting service.
ReplaceDiscontinuedService
The registration is to replace another service that has been discontinued.
LocalHolidayChange
The change is to accommodate a local holiday.
SpecialOccasion
The change is to allow for a special occasion.
RegulationOrderCompliance
The change is to comply with a traffic order note.
ChangeRequestedByExternalAuthority
The change is to comply with a request from an external authority such as the Police.
ExceptionalRequirement
The change is to accommodate an exceptional requirement.
MiscellaneousJustification
Reasons justifying short notice registration submission where no predefined ShortNoticeRegistration reasons are applicable. @lang.

Figure 6-29 – ShortNoticeRegistration / ChangeJustificationGroup

6.5.12 ShortNoticeRegistration Subelements

6.5.12.1 ShortNoticeRegistration / Public Availability Element

The ***PublicAvailability*** element (*Figure 6-30*) specifies whether the service is to be available to the general public.

- ***AvailableToPublic***: Specifies service is available.
- ***NotAvailableToPublic***. Specifies service is not available, accompanied by a ***NonAvailabilityDescription.***

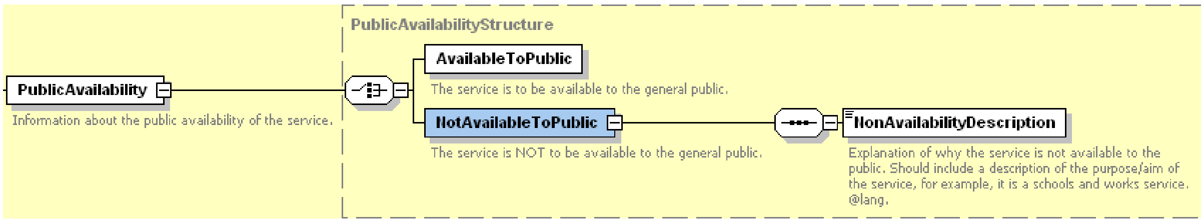

PublicAvailabilityStructure
PublicAvailability
Information about the public availability of the service.
AvailableToPublic
The service is to be available to the general public.
NotAvailableToPublic
The service is NOT to be available to the general public.
NonAvailabilityDescription
Explanation of why the service is not available to the public. Should include a description of the purpose/aim of the service, for example, it is a schools and works service. @lang.

Figure 6-30 – ShortNoticeRegistration / PublicAvailability Element

6.5.12.2 ShortNoticeRegistration / ChangeImpact Element

The ***ChangeImpact*** element (*Figure 6-31*) specifies whether the change to the service time is in excess of the normal allowed limit (i.e. more than ten minutes from the current time): if the change is more than the allowed amount, then a justification must be given, otherwise a Minor Change Description can be used.

- ***ChangeExceedsLimit***: Change exceeds the allowed limit. Only possible if change to existing application, i.e. if ***ChangeClassification*** is ***Change*** or ***Cancel.***
- ***ChangeDoesNotExceedLimit:*** The change does not exceed the limit.

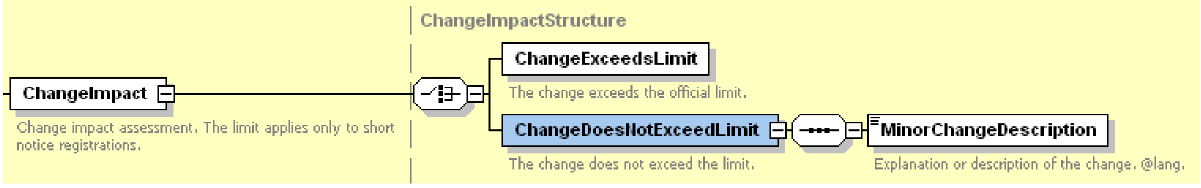

ChangeImpactStructure
ChangeImpact
Change impact assessment. The limit applies only to short notice registrations.
ChangeExceedsLimit
The change exceeds the official limit.
ChangeDoesNotExceedLimit
The change does not exceed the limit.
MinorChangeDescription
Explanation or description of the change. @lang.

Figure 6-31 – ShortNoticeRegistration / ChangeImpact Element

6.5.12.3 ShortNoticeRegistration / ChangeToConnectAlteredService Element

The ***ChangeToConnectAlteredService*** (Figure *6-32*) specifies whether the short notice registration is needed to handle a modification to another service, and if so, which one:
It contains an ***AlteredServiceRequiringConnection*** instance, which is an ***AnnotatedServiceRefStructure.***

- ***ServiceRef:*** Reference to another ***Service*** definition provided elsewhere in the document.
- ***Description:*** Text description of the service &/or its identifier if not defined by a service reference.

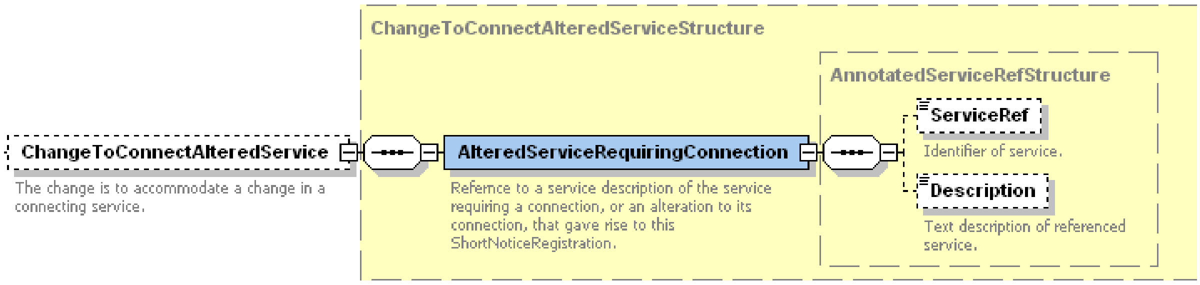

ChangeToConnectAlteredServiceStructure
ChangeToConnectAlteredService
The change is to accommodate a change in a connecting service.
AlteredServiceRequiringConnection
Refernce to a service description of the service requiring a connection, or an alteration to its connection, that gave rise to this ShortNoticeRegistration.
AnnotatedServiceRefStructure
ServiceRef
Identifier of service.
Description
Text description of referenced service.

Figure 6-32 – ShortNoticeRegistration / ChangeToConnectAlteredService Element

6.5.12.4 ShortNoticeRegistration / ReplaceDiscontinuedService Element

The ***ReplaceDiscontinuedService*** (*Figure 6-33*) identifies the discontinued service which the service of the short notice registration replaces.

- ***DiscontinuedServiceOperator:*** Operator of the discontinued service.

DiscontinuedService: Description of the discontinued service, an ***AnnotatedServiceRefStructure.***

- ***ServiceRef:*** Reference to another ***Service*** definition provided elsewhere in the document.
- ***Description:*** Text description of the service &/or its identifier if not defined by a service reference.

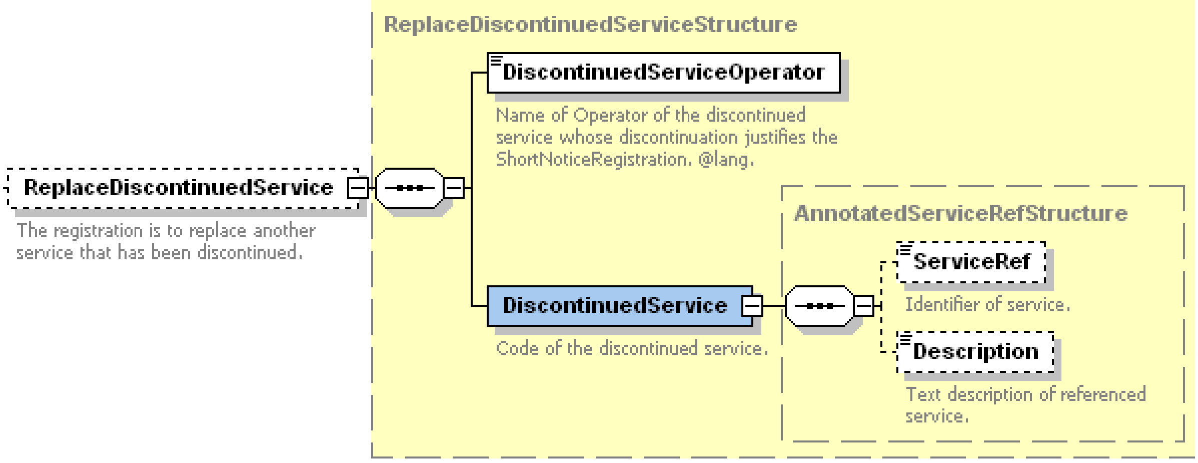

ReplaceDiscontinuedServiceStructure
DiscontinuedServiceOperator
Name of Operator of the discontinued service whose discontinuation justifies the ShortNoticeRegistration. @lang.
ReplaceDiscontinuedService
The registration is to replace another service that has been discontinued.
AnnotatedServiceRefStructure
ServiceRef
Identifier of service.
DiscontinuedService
Code of the discontinued service.
Description
Text description of referenced service.

Figure 6-33 – ShortNoticeRegistration / ReplaceDiscontinuedService Element

6.5.12.5 ShortNoticeRegistration / LocalHolidayChange Element

The ***LocalHolidayChange*** element (*Figure 6-34*) identifies the local holiday which justifies the short notice registration.

- ***LocalHolidayNote***: Description of local holiday.

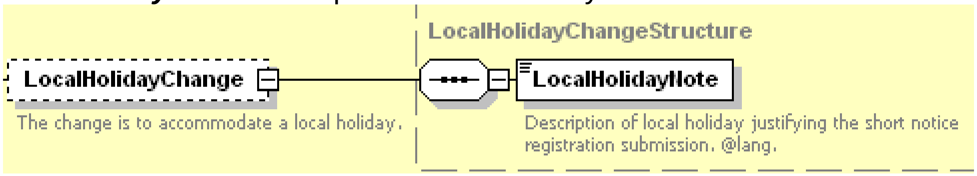

LocalHolidayChangeStructure
LocalHolidayChange
The change is to accommodate a local holiday.
LocalHolidayNote
Description of local holiday justifying the short notice registration submission. @lang.

Figure 6-34 – ShortNoticeRegistration / LocalHolidayChange Element

6.5.12.6 ShortNoticeRegistration / SpecialOccasion Element

The ***SpecialOccasion*** element (*Figure 6-35*) identifies the special occasion which justifies the short notice registration.

- ***SpecialOccasionName***: Name of special occasion.

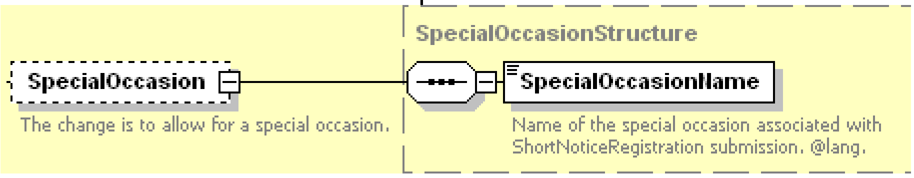

SpecialOccasionStructure
SpecialOccasion
The change is to allow for a special occasion.
SpecialOccasionName
Name of the special occasion associated with ShortNoticeRegistration submission. @lang.

Figure 6-35 – ShortNoticeRegistration / SpecialOccasion Element

6.5.12.7 ShortNoticeRegistration / RegulationOrderCompliance Element

The ***RegulationOrderCompliance*** element (*Figure 6-36*) identifies whether the short notice registration is to comply with a regulation order.

- ***TrafficOrderNote:*** Identifies the order.

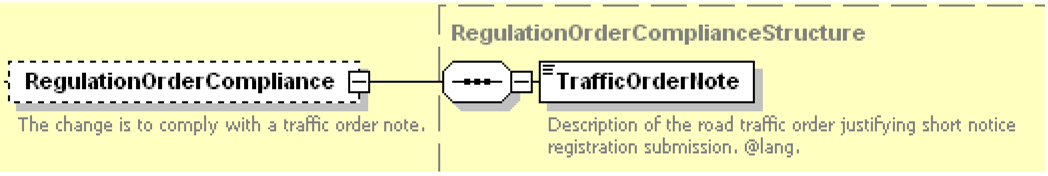

RegulationOrderComplianceStructure
RegulationOrderCompliance
The change is to comply with a traffic order note.
TrafficOrderNote
Description of the road traffic order justifying short notice registration submission. @lang.

Figure 6-36 – ShortNoticeRegistration / RegulationOrderCompliance Element

6.5.12.8 ShortNoticeRegistration / ChangeRequestedByExternalAuthority Element

The ***ChangeRequestedByExternalAuthority*** (*Figure 6-37*) specifies whether the short notice registration is needed to meet a request by an external authority such as the Police, and any explanation or corroboration of the change.

- ***ChangeRequestDescription***: Explanation or corroboration of why the change is required.

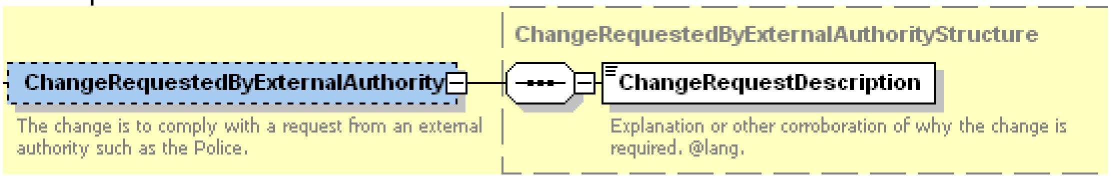

ChangeRequestedByExternalAuthorityStructure
ChangeRequestedByExternalAuthority
The change is to comply with a request from an external authority such as the Police.
ChangeRequestDescription
Explanation or other corroboration of why the change is required. @lang.

Figure 6-37 – ShortNoticeRegistration / ChangeRequestedByExternalAuthority Element

6.5.12.9 ShortNoticeRegistration / ExceptionalRequirement Element

The ***ExceptionalRequirement*** element (*Figure 6-38*) specified whether the registration is needed to meet an allowed exceptional requirement.

- ***ChangeRequestDescription***: Explanation or corroboration of why the change is required.

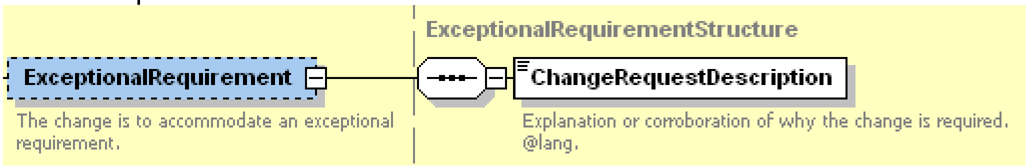

ExceptionalRequirementStructure
ExceptionalRequirement
The change is to accommodate an exceptional requirement.
ChangeRequestDescription
Explanation or corroboration of why the change is required. @lang.

Figure 6-38 – ShortNoticeRegistration / ExceptionalRequirement Element

6.6 Service Description Elements

6.6.1 Services Element

Definitions of each ***Service*** describing a bus schedule are contained within the ***Services*** container element***:***

- In a *TransXChange Registration* schema document, only one registered service may be described at a time. The registered ***Service*** must reference a ***Registration***, and the referenced ***Registration*** must describe the operator in full with a ***LicensedOperator***. Instance. Relevant details of other connecting services may be included in the document as separate service declarations.
- In a *TransXChange General* Schema document, many services can be described.

6.6.2 Service Element

The ***Service*** element (*Figure 6-39*) describes a service. The elements include:

- ***ServiceCode***: The unique identifier for the service.
- ***PrivateCode***: An identifier for the service that can be used to associate it with other systems.
- ***Lines***: The public identifiers for the service. See later.
- ***OperatingPeriod***: Period within which service operates. See below.
- ***OperatingProfile:*** Default operational days for journeys running the service. See Operational Days elements later.
- ***ServiceClassification***: Type of the service. See below.
- ***TicketMachineServiceCode:*** Unique Identifier associated with service for use in ticketing machine systems. May be overridden on Individual Journey Patterns & Vehicle Journey instances.
- ***RegisteredOperatorRef***: Registered operator of the service. See ***LicensedOperator*** and ***Operator***. On a ***Registration Service*** this must reference a ***LicensedOperator*** instance.
- ***AssociatedOperatorRef:*** Another operator associated with the service in a secondary capacity. See ***Operator*** and ***LicensedOperator***.
- ***ServiceInfoGroup:*** Further informational elements about the service. See below.
- ***ServiceDescriptionGroup:*** Further descriptive elements about the service. See below.
- ***ServiceComponentGroup:*** Information about the routes and journeys patterns comprising the service. See below.

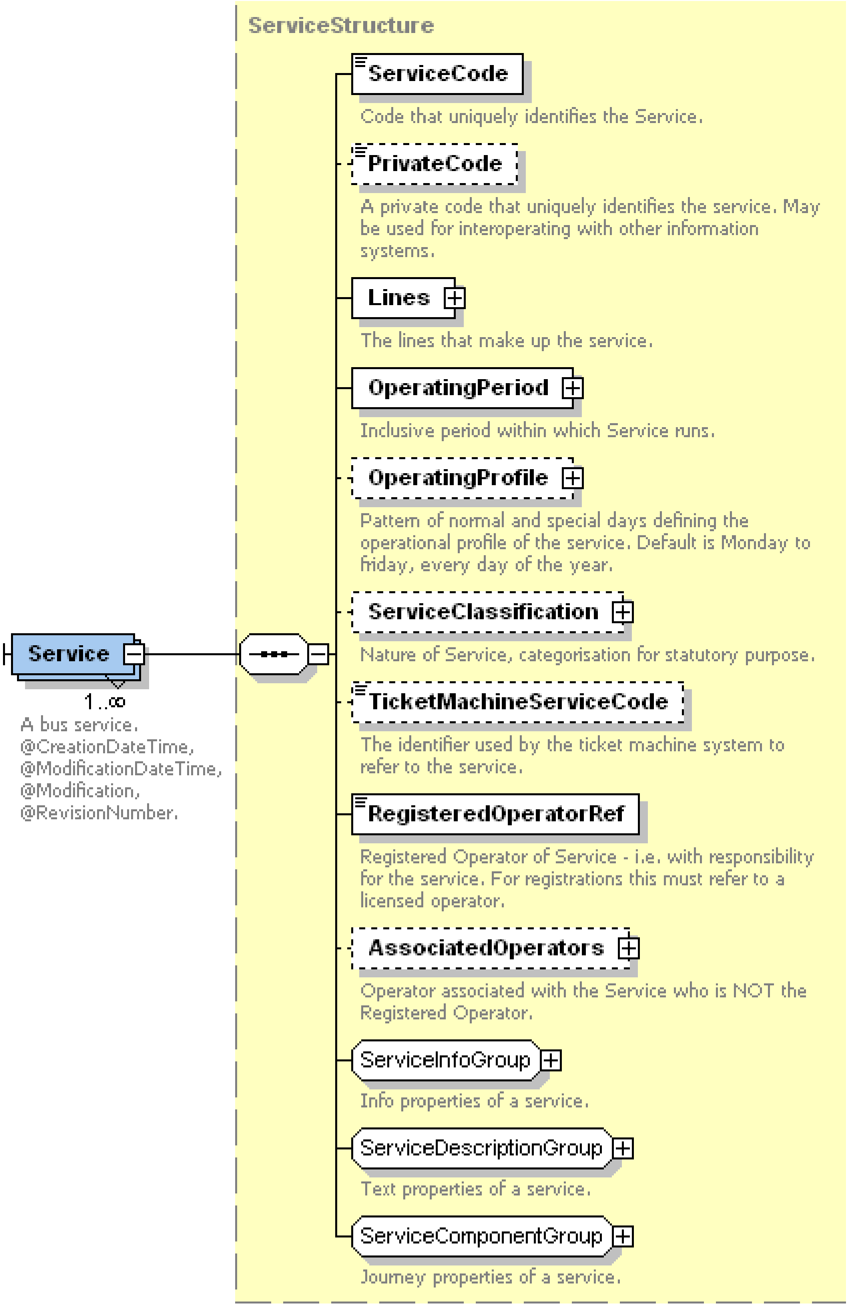

ServiceStructure
ServiceCode
Code that uniquely identifies the Service.
PrivateCode
A private code that uniquely identifies the service. May be used for interoperating with other information systems.
Lines
The lines that make up the service.
OperatingPeriod
Inclusive period within which Service runs.
OperatingProfile
Pattern of normal and special days defining the operational profile of the service. Default is Monday to friday, every day of the year.
ServiceClassification
Nature of Service, categorisation for statutory purpose.
Service
1..∞
A bus service. @CreationDateTime, @ModificationDateTime, @Modification, @RevisionNumber.
TicketMachineServiceCode
The identifier used by the ticket machine system to refer to the service.
RegisteredOperatorRef
Registered Operator of Service - i.e. with responsibility for the service. For registrations this must refer to a licensed operator.
AssociatedOperators
Operator associated with the Service who is NOT the Registered Operator.
ServiceInfoGroup
Info properties of a service.
ServiceDescriptionGroup
Text properties of a service.
ServiceComponentGroup
Journey properties of a service.

Figure 6-39 – Service Element

6.6.3 Service / ServiceInfoGroup

The ***ServiceInfoGroup*** (*Figure 6-40*) group holds informational elements describing the ***Service***.

- ***ServiceHasMirror***: Whether service has a corresponding service in the return direction.
- ***StopRequirements:*** Whether the service requires new stop declarations. See below.
- ***Mode***: Transport mode of service. See *Table 6-10*. Default is bus.

Value	Description
air	Air service.
bus	Bus service.
coach	Coach service.

underground	Metro service.
ferry	Ferry service.
train	Train service.
tram	Tram service.
underground	Underground service.

Table 6-10 – Allowed Values for Service / Mode

- ***PublicUse***: Whether service allows public use, i.e. is not 'Closed Door'.
- ***ServiceAvailability***: Whether service has a corresponding service in the return direction. See below.
- ***Express***: Whether service is flagged as an express (i.e. limited stop) service.

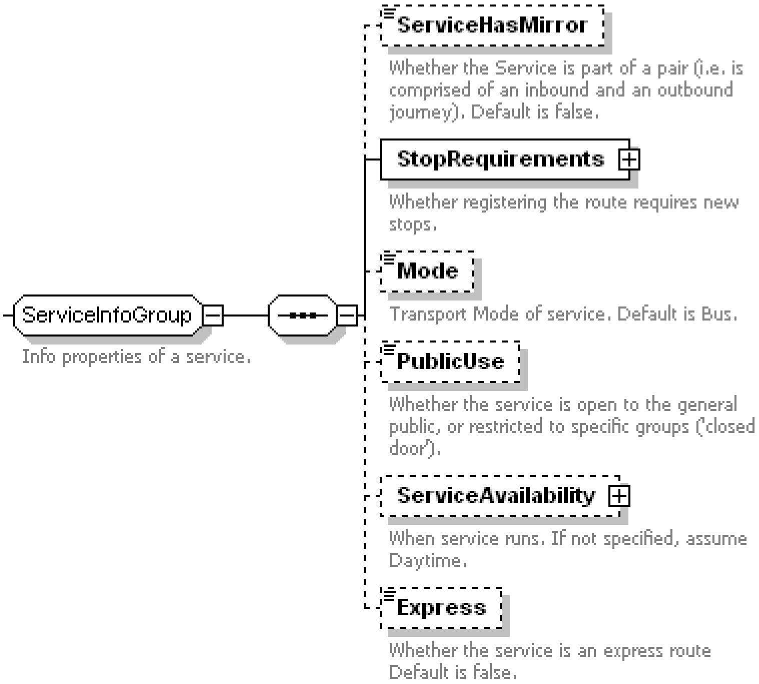

ServiceHasMirror
Whether the Service is part of a pair (i.e. is comprised of an inbound and an outbound journey). Default is false.
StopRequirements
Whether registering the route requires new stops.
Mode
Transport Mode of service. Default is Bus.
ServiceInfoGroup
Info properties of a service.
PublicUse
Whether the service is open to the general public, or restricted to specific groups ('closed door').
ServiceAvailability
When service runs. If not specified, assume Daytime.
Express
Whether the service is an express route Default is false.

Figure 6-40 – Service / ServiceInfoGroup

6.6.4 Service / ServiceDescriptionGroup

The ***ServiceDescriptionGroup*** (*Figure 6-41***)** group holds ancillary descriptive elements describing the Service.

- ***Description:*** Text description of the services. On registrations should include "A description of the service or change for Notices & Proceedings". For example, "*a regular service at half-hourly intervals daytime on Mondays to Saturdays, and hourly in the evenings and on Sundays*".
- ***Note:*** Structured notes associated with service. See common schema elements later.
- ***SchematicMap:*** Name of any schematic map associated with services. File name. Must be an image file (.png, .gif, .jpeg). Schematic maps must be provided for Registrations.
- ***ToBeMarketedWith:*** Information on marketing of the services. See below.

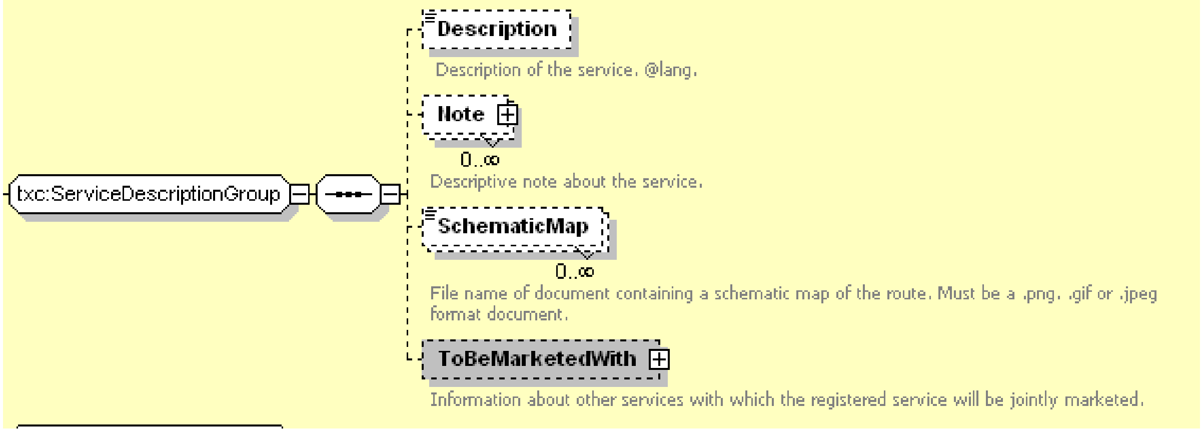

Description
Description of the service. @lang.
Note
0..∞
Descriptive note about the service.
txc:ServiceDescriptionGroup
SchematicMap
0..∞
File name of document containing a schematic map of the route. Must be a .png. .gif or .jpeg format document.
ToBeMarketedWith
Information about other services with which the registered service will be jointly marketed.

Figure 6-41 – Service / ServiceDescriptionGroup

6.6.5 Service / ServiceComponentGroup

The ***ServiceComponentGroup*** (*Figure 6-42***)** holds the fundamental timetable components of the Service.

- ***StandardService:*** Any standard service component.
- ***FlexibleService:*** Any flexible service component.
- ***Direction:*** The direction of the ***Service***. See *Table 6-1*

Value	Description
inbound	Inbound Direction.
outbound	Outbound Direction.
inboundAndOutbound	Inbound and Outbound Direction.
circular	Circular Direction.
clockwise	Clockwise Direction.
antiClockwise	Anti-Clockwise Direction.

Table 6-11 – Allowed Values for Service / Direction

- ***JourneyPatternInterchange***: Zero or more interchanges at which the journey patterns of the service connect.

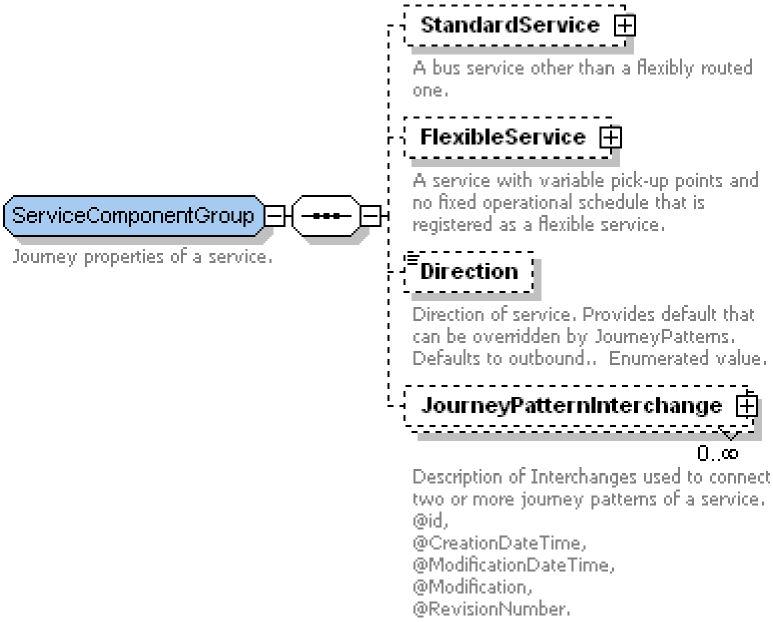

StandardService
A bus service other than a flexibly routed one.
FlexibleService
A service with variable pick-up points and no fixed operational schedule that is registered as a flexible service.
ServiceComponentGroup
Journey properties of a service.
Direction
Direction of service. Provides default that can be overridden by JourneyPatterns. Defaults to outbound.. Enumerated value.
JourneyPatternInterchange
0..∞
Description of Interchanges used to connect two or more journey patterns of a service.
@id,
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.

Figure 6-42 – Service / ServiceComponentGroup

6.6.6 Service / Subelements

6.6.6.1 Service / Line Element

The ***Line*** element (*Figure 6-43*) allows one or more public identifiers of the service to be associated with the vehicle journeys of the service. For example, lines '1', '1a', '1b'. Each individual ***VehicleJourney*** element specifies the line or line variant that the journey runs. A ***Line*** provides an arbitrary label for presentational and marketing purposes and does not necessarily correspond to the strict route variants: the same line name may be used on services with different stopping patterns. A ***Line*** is identified by a unique ***id*** attribute.

- Each ***Line*** has a ***LineName***.

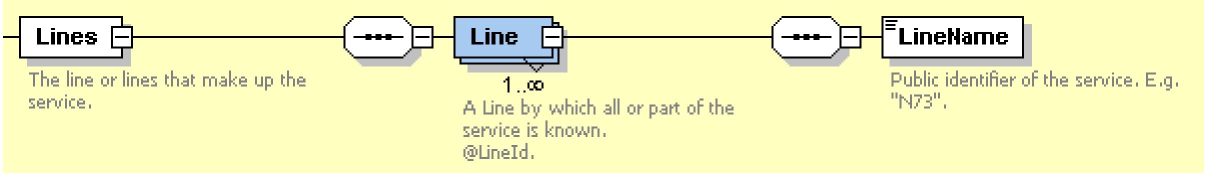

Lines
The line or lines that make up the service.
Line
1..∞
A Line by which all or part of the service is known. @LineId.
LineName
Public identifier of the service. E.g. "N73".

Figure 6-43 – Service / Line Element

6.6.6.2 Service / OperatingPeriod Element

The ***OperatingPeriod*** element (*Figure 6-44*) states the period over which the ***Service*** operates. It includes a ***StartDate*** and an option ***EndDate***. See also ***OperationProfile*** element for further elements relating to the operating days of a service.

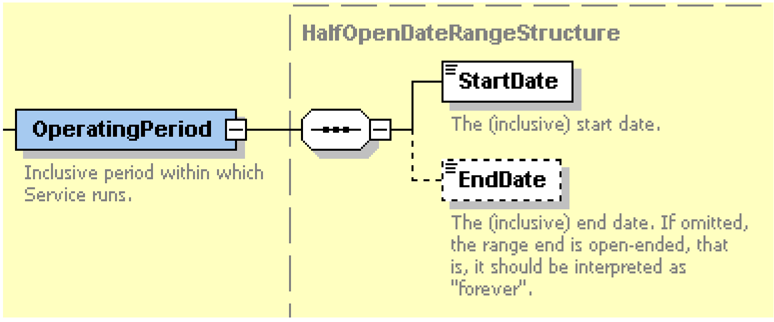

HalfOpenDateRangeStructure
StartDate
The (inclusive) start date.
OperatingPeriod
Inclusive period within which Service runs.
EndDate
The (inclusive) end date. If omitted, the range end is open-ended, that is, it should be interpreted as "forever".

Figure 6-44 – Service / OperatingPeriod Element

6.6.6.3 Service / ServiceClassification Element

The ***ServiceClassification*** element (*Figure 6-45*) classifies the service as being one or more of a number of categories of service. The classifications are as follows:

- ***NormalStopping:*** A service where all stops on a route are used.
- ***LimitedStops:*** A service where only certain pre-defined stops on a route are used.
- ***HailAndRide:*** A service that stops anywhere on designated parts of the route, if flagged down by passengers where it is safe to do so.
- ***Flexible:*** A service running in accordance with the rules for a flexible service, with designated pickup and set down zones or points. Must be specified if service is a ***FlexibleService***.
- ***ExcursionOrTour:*** A service where all passengers go to the same destination and return to their departure point. Further qualified by:
  - ***MaxDepartures***: Maximum number of vehicle departures within one day associated with an excursion type service.
- ***RuralService:*** A service primarily aimed at serving rural communities (i.e. at locations with populations less than 25,000 people).
- ***SchoolOrWorks:*** A service dedicated to a school or works that is not available to the public.

- ***OtherService:*** Services that do not fit any of the defined categories. Should only be used sparingly:
    - Further explained by a ***Description***.

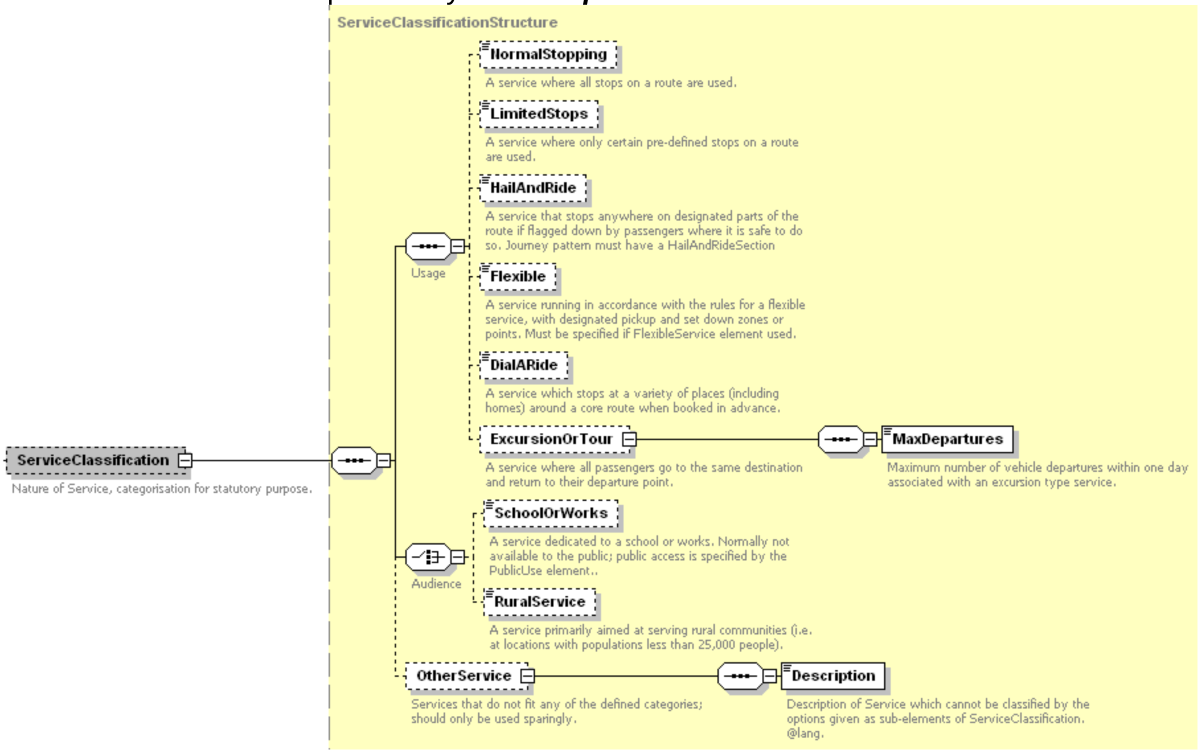

ServiceClassificationStructure
NormalStopping
A service where all stops on a route are used.
LimitedStops
A service where only certain pre-defined stops on a route are used.
HailAndRide
A service that stops anywhere on designated parts of the route if flagged down by passengers where it is safe to do so. Journey pattern must have a HailAndRideSection
Usage
Flexible
A service running in accordance with the rules for a flexible service, with designated pickup and set down zones or points. Must be specified if FlexibleService element used.
DialARide
A service which stops at a variety of places (including homes) around a core route when booked in advance.
ExcursionOrTour
A service where all passengers go to the same destination and return to their departure point.
MaxDepartures
Maximum number of vehicle departures within one day associated with an excursion type service.
ServiceClassification
Nature of Service, categorisation for statutory purpose.
SchoolOrWorks
A service dedicated to a school or works. Normally not available to the public; public access is specified by the PublicUse element..
Audience
RuralService
A service primarily aimed at serving rural communities (i.e. at locations with populations less than 25,000 people).
OtherService
Services that do not fit any of the defined categories; should only be used sparingly.
Description
Description of Service which cannot be classified by the options given as sub-elements of ServiceClassification. @lang.

Figure 6-45 – Service / ServiceClassification Element

Normal combinations of service are shown in *Table 6-12*:

		Audience						
Group	**ServiceClassification**	**Normal Stop-ping**	**Limited Stops**	**Hail And Ride**	**Flexible Service**	**Excursion Or Tour**	**School Or Works**	**Rural Serv-ice**
Operation	***NormalStopping***	-	N	N	N	N	Y	Y
	LimitedStops	N	-	N	N	N	Y	Y
	HailAndRide	N	N	-	N	N	Y	Y
	FlexibleService	N	N	N	-	N	Y	Y
	ExcursionOrTour	N	N	N	N	-	Y	Y
	OtherService	N	N	N	N	N	Y	Y
Purpose	***SchoolOrWorks***	Y	Y	Y	Y	Y	-	N
	RuralService	Y	Y	Y	Y	Y	N	-

Table 6-12 – Allowed ServiceClassification Combinations

6.6.6.4 Service / AssociatedOperators Element

The ***AssociatedOperators*** (*Figure 6-46*) element records details about any operators associated with the service other than the registered operator. The ***AssociatedOperator*** comprises:

- ***OperatorRef:*** Reference to an ***Operator*** or ***LicensedOperator*** definition. See above.
- ***Role:*** Description of the role of the associated operator.

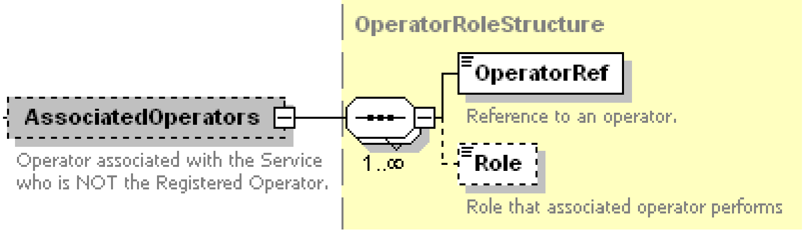

OperatorRoleStructure
OperatorRef
Reference to an operator.
AssociatedOperators
Operator associated with the Service who is NOT the Registered Operator.
1..∞
Role
Role that associated operator performs

Figure 6-46 – Service / AssociatedOperators Element

6.6.6.5 Service / StopRequirements Element

The ***StopRequirements*** element (*Figure 6-47*) specifies whether a service does or does not require any new stops.

- ***NoNewStopsRequired:*** No new stops are needed.
- ***NewStops:*** New stops are needed.
  - ***StopPointRef***: Reference to the new stop – may be declared locally.
  - ***Note:*** Optional explanatory note accompanying definition.

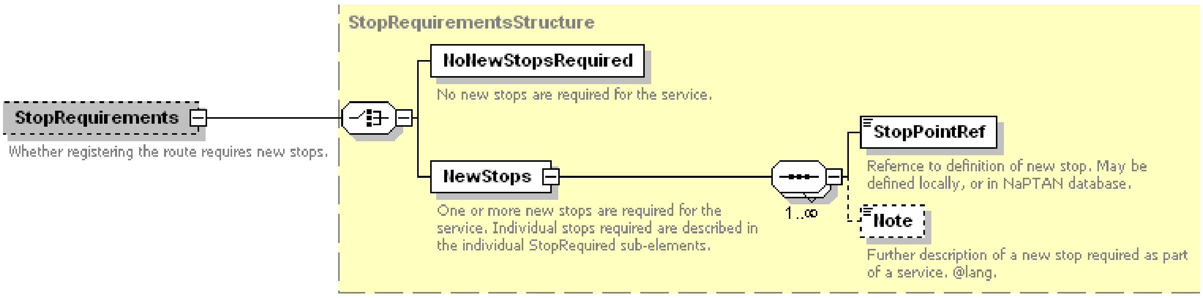

StopRequirementsStructure
StopRequirements
Whether registering the route requires new stops.
NoNewStopsRequired
No new stops are required for the service.
NewStops
One or more new stops are required for the service. Individual stops required are described in the individual StopRequired sub-elements.
1..∞
StopPointRef
Refernce to definition of new stop. May be defined locally, or in NaPTAN database.
Note
Further description of a new stop required as part of a service. @lang.

Figure 6-47 – Service / StopRequirements Element

6.6.6.6 Service / ServiceAvailability Element

The ***ServiceAvailability*** element *(Figure 6-48*) specifies the time of day a service runs as a broad classification. One of the following:

- ***TwentyFourHours:*** Service runs all day and all night continuously.
- ***Daytime:*** Service runs in daytime.
- ***Peak:*** Service runs in peak hours only.
- ***OffPeak:*** Service runs in off-peak hours only.
- ***Night:*** Service is a night service.

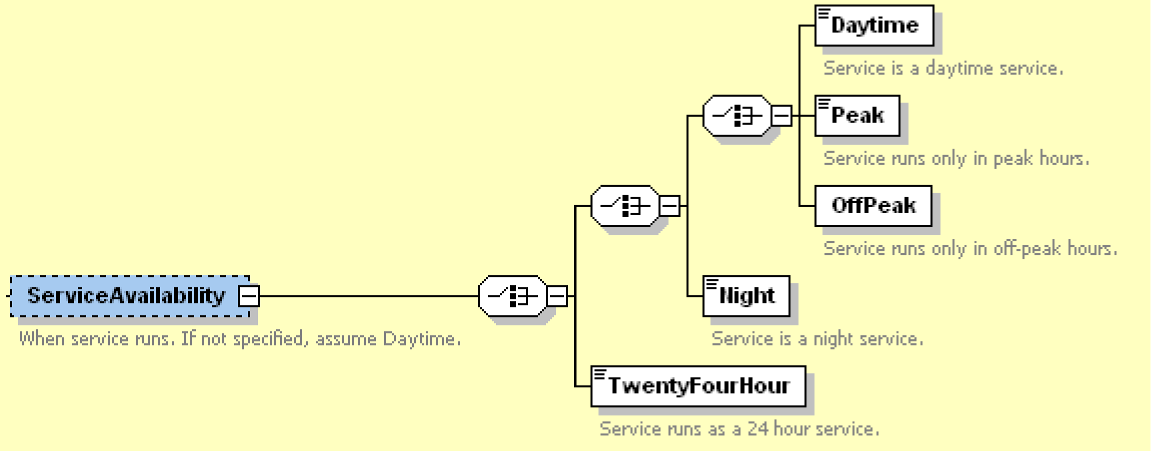

ServiceAvailability
When service runs. If not specified, assume Daytime.
Daytime
Service is a daytime service.
Peak
Service runs only in peak hours.
OffPeak
Service runs only in off-peak hours.
Night
Service is a night service.
TwentyFourHour
Service runs as a 24 hour service.

Figure 6-48 – Service / ServiceAvailability Element

6.6.6.7 Service / ToBeMarketedWith Element

The ***ToBeMarketedWith*** element (*Figure 6-49*) records the Services that are normally marketed with the bus service. It contains one or more ***RelatedService*** instances, each of which is an ***AnnotatedServiceRefStructure.***

- ***ServiceRef:*** Reference to another ***Service*** definition provided elsewhere in the document.
- ***Description:*** Text description of the service &/or its identifier if not defined by a service reference.

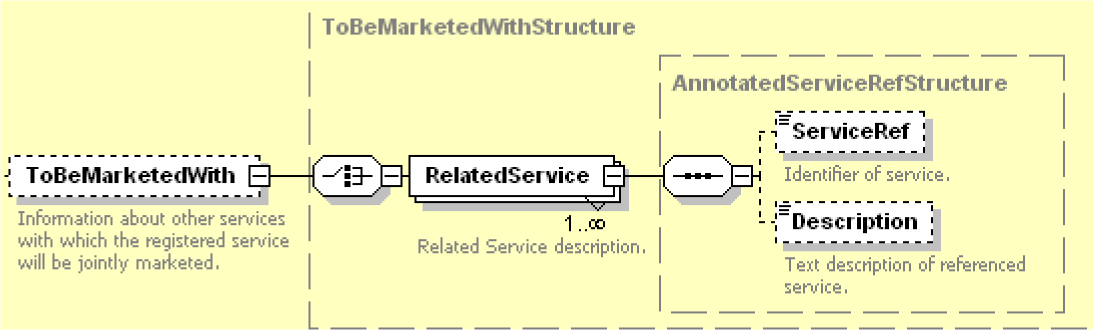

ToBeMarketedWithStructure
AnnotatedServiceRefStructure
ToBeMarketedWith
Information about other services with which the registered service will be jointly marketed.
RelatedService
1..∞
Related Service description.
ServiceRef
Identifier of service.
Description
Text description of referenced service.

Figure 6-49 – Service / ToBeMarketedWith Element

6.7 StandardService, JourneyPattern, VehicleJourney

6.7.1 StandardService Element

The ***StandardService*** element (*Figure 6-50*) describes the fixed-route component of a ***Service***. It comprises.

- ***Origin***: Public name of the place where the service starts.
- ***Destination:*** Public name of the place where the service ends.
- ***Vias:*** Public name(s) of the places that the service route goes past: One or more ***Via*** elements.
- ***UseAllStopPoints:*** Whether the service uses all the stops along its ***Route***.
- ***JourneyPattern***: One or more ***JourneyPattern*** elements representing the working of the service. See below.

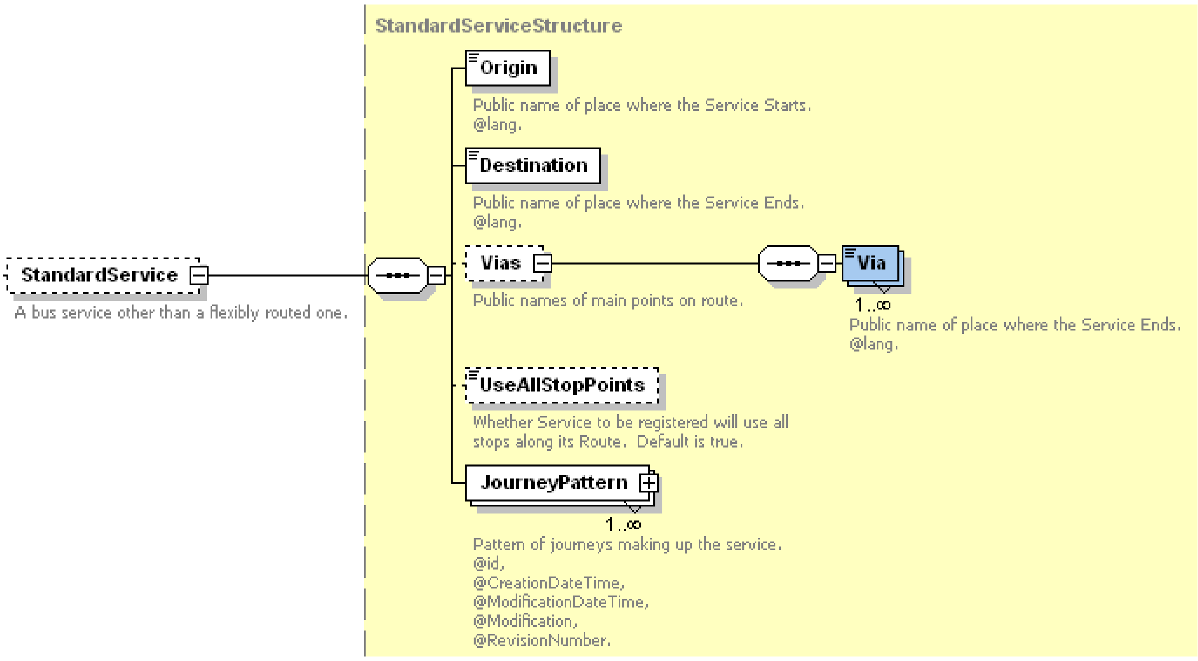

StandardServiceStructure
StandardService
A bus service other than a flexibly routed one.
Origin
Public name of place where the Service Starts.
@lang.
Destination
Public name of place where the Service Ends.
@lang.
Vias
Public names of main points on route.
Via
1..∞
Public name of place where the Service Ends.
@lang.
UseAllStopPoints
Whether Service to be registered will use all stops along its Route. Default is true.
JourneyPattern
1..∞
Pattern of journeys making up the service.
@id,
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.

Figure 6-50 – StandardService Element

6.7.2 JourneyPatterns

A ***JourneyPattern*** describes a possible bus route of a ***StandardService*** as a sequence of timing links between stops that a vehicle will traverse in a particular order, representing the pattern of working for vehicles of the service.

- Each ***JourneyPattern*** belongs to a ***StandardService***.
- The individual steps of the journey are modelled as ***JourneyPatternTimingLink*** elements; each link has information about the distance to travel, between two stops, and the run time needed. Activity at stop and other information about stop usage is described for each end of the link using ***JourneyPatternStopUsage*** elements.
- The links are grouped into ***JourneyPatternSection*** elements, representing reusable link sequences. Sections are declared within a ***TransXChange*** top-level container element, ***JourneyPatternSections***, and so may be reused in different ***JourneyPattern*** instances.
- The order of ***JourneyPatternTimingLinks*** in each ***JourneyPatternSection,*** and the overall order of the ***JourneyPatternSection*** instances must both follow the order in which they are traversed.
- The timing links of a ***JourneyPattern*** should correspond to the ***RouteLink*** instances of any associated ***Route***, that is be an exact projection on a link-by-link basis of either all the links of route in sequence, or a contiguous subset of the route links in sequence
- In a given ***JourneyPattern,*** the route links of an individual ***RouteSection*** should all be referenced by timing links in a single ***JourneyPatternSection,*** i.e. not be divided between different ***JourneyPatternSection*** instances. A ***JourneyPatternSection*** may however project onto multiple ***RouteSection*** instances.
- A ***JourneyPattern*** may be used in more than one ***VehicleJourney*** on a route. It should be noted that a ***VehicleJourney*** following a ***JourneyPattern*** may not necessarily stop at all stops identified within the ***JourneyPattern***, thus the ***JourneyPattern*** provides the ‘super set’ of stops of a route, of which all or some may be served by the dependent ***VehicleJourney*** instances. Individual ***VehicleJourney*** instances may subset the full ***JourneyPattern*** stop list either by passing an individual stop, or by short working at either end. They must still follow the route and stop sequence for the part of the journey pattern that they work.

6.7.3 JourneyPattern Element

A ***JourneyPattern*** (*Figure 6-51*) describes the stopping pattern of a standard i.e. fixed route service. A ***JourneyPattern***, is identified by a unique ***id*** attribute, and comprises a number of elements falling into two groups:

1. ***CommonJourneyGroup:*** Shared elements common to journey patterns and vehicle journeys.
2. ***JourneyPatternGroup:*** Elements specific to journey patterns.

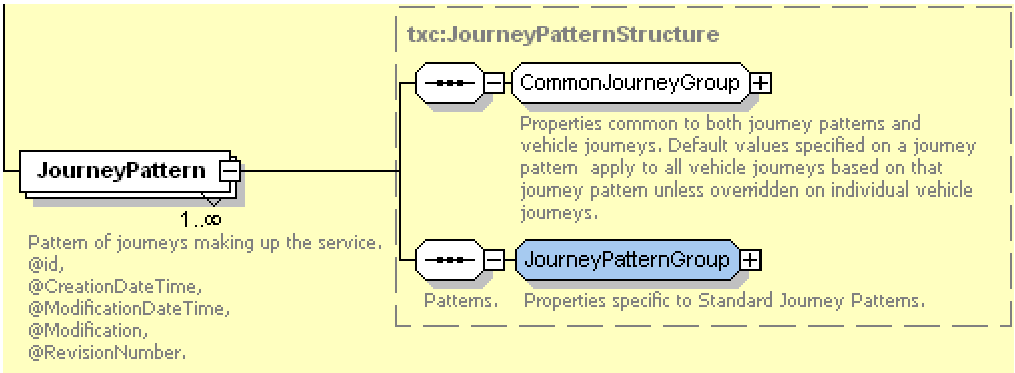

txc:JourneyPatternStructure
CommonJourneyGroup
Properties common to both journey patterns and vehicle journeys. Default values specified on a journey pattern apply to all vehicle journeys based on that journey pattern unless overridden on individual vehicle journeys.
JourneyPattern
1..∞
Pattern of journeys making up the service. @id, @CreationDateTime, @ModificationDateTime, @Modification, @RevisionNumber.
JourneyPatternGroup
Patterns.
Properties specific to Standard Journey Patterns.

Figure 6-51 – JourneyPattern Element

6.7.3.1 JourneyPattern / CommonJourneyGroup

The ***CommonJourneyGroup*** (*Figure 6-52*) holds identity and operational information that is common to both a ***JourneyPattern*** and a ***VehicleJourney:*** the ***JourneyPattern*** instances provide default values to use on dependent ***VehicleJourney*** instances if no specific override is provided on the ***VehicleJourney***.

- ***PrivateCode***: A unique private code that can be used to identify the ***JourneyPattern***.
- ***DestinationDisplay***: Journey destination, as displayed on vehicle. If omitted, the ***Destination*** of the ***Service*** is used.
- ***OperatorRef:*** The operator for the journey. Normally this is not required since it is the same as for the service.
- ***Direction***: The default ***Direction*** of the ***JourneyPattern.*** Default is '*inherit*'. See *Table 6-13.*

Value	Description
inherit	Use value from Service.
inbound	Inbound Direction.
outbound	Outbound Direction.
clockwise	Clockwise Direction.
antiClockwise	Anti-Clockwise Direction.

Table 6-13 – Allowed Values for JourneyPattern / Direction

- ***OperatingProfile:*** Specifies operational days and times associated with the JourneyPattern. If not specified inherited from ***Service***.
- ***Operational:*** Specifies additional operational information associated with the journey. See below. Normally this is not required since it is the same as for the service. Includes ***TicketMachine*** and ***Block*** elements. See below.
- ***LayoverPoint***: Points at which the service lays over. See below.
- ***GarageRef***: A garage from which the ***Service*** operates.
- ***TimeDemand***: Classification of the route as to when peak demand occurs. See *Table 6-14*.

Value	Description
earlyMorning	Early Morning.
offPeak	Off Peak.
peakMorning	Peak Morning.
peakAfternoon	Peak Afternoon.
evening	Evening.
lateEvening	Late Evening.
saturdayMorning	Saturday Morning.
saturdayDaytime	Saturday Daytime.
saturdayEvening	Saturday Evening.
sunday	Sunday.
bankHoliday	Bank Holiday.

Table 6-14 – Allowed Values for TimeDemand

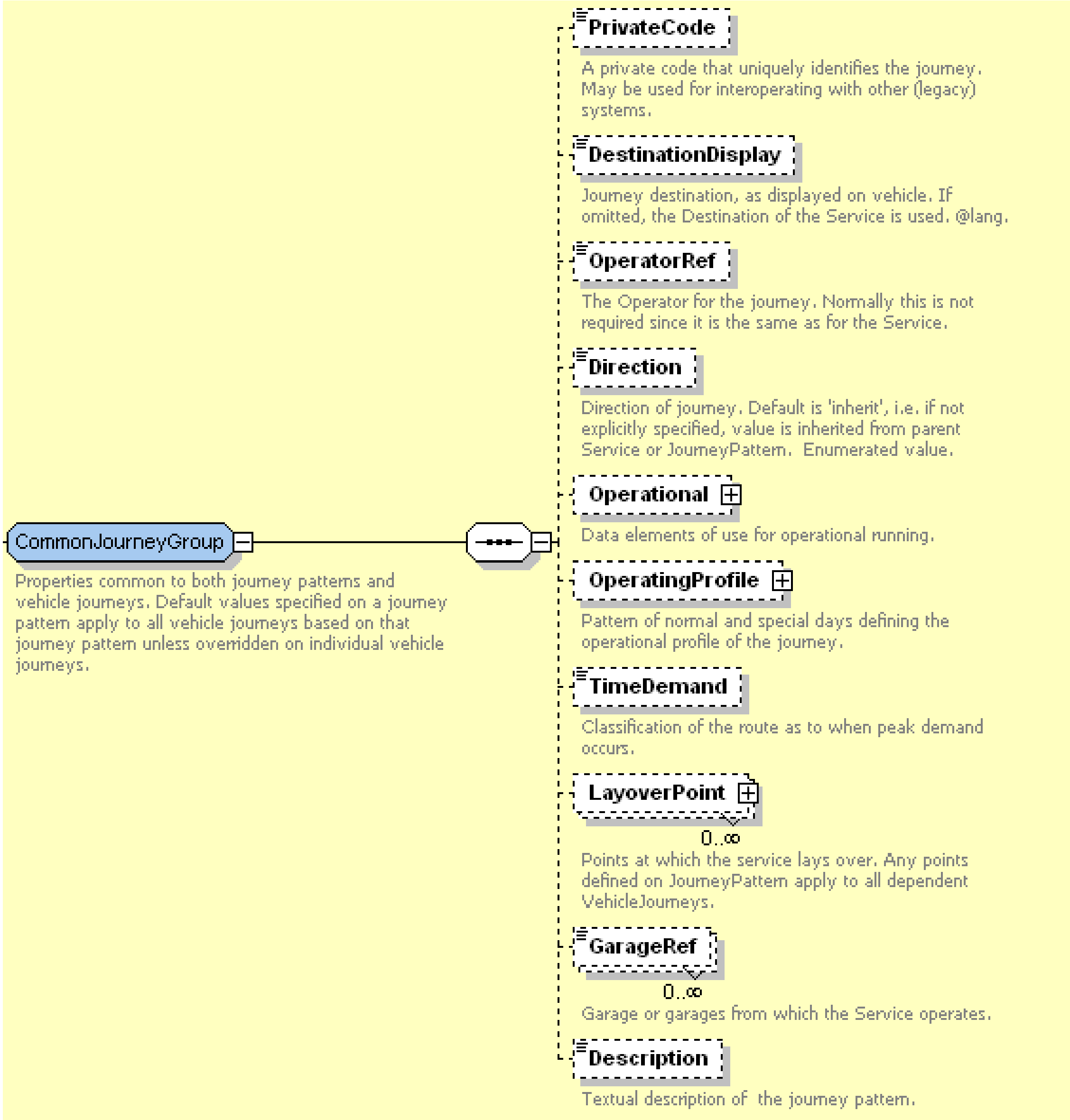

PrivateCode
A private code that uniquely identifies the journey. May be used for interoperating with other (legacy) systems.
DestinationDisplay
Journey destination, as displayed on vehicle. If omitted, the Destination of the Service is used. @lang.
OperatorRef
The Operator for the journey. Normally this is not required since it is the same as for the Service.
Direction
Direction of journey. Default is 'inherit', i.e. if not explicitly specified, value is inherited from parent Service or JourneyPattern. Enumerated value.
Operational
Data elements of use for operational running.
CommonJourneyGroup
Properties common to both journey patterns and vehicle journeys. Default values specified on a journey pattern apply to all vehicle journeys based on that journey pattern unless overridden on individual vehicle journeys.
OperatingProfile
Pattern of normal and special days defining the operational profile of the journey.
TimeDemand
Classification of the route as to when peak demand occurs.
LayoverPoint
0..∞
Points at which the service lays over. Any points defined on JourneyPattern apply to all dependent VehicleJourneys.
GarageRef
0..∞
Garage or garages from which the Service operates.
Description
Textual description of the journey pattern.

Figure 6-52 – JourneyPattern / CommonJourneyGroup

6.7.3.2 JourneyPattern / JourneyPatternGroup

The JourneyPatternGroup holds information specific to a ***JourneyPattern:***

- ***RouteRef***: The ***Route*** which the ***JourneyPattern*** follows. See ***Route*** above.
- ***JourneyPatternSectionRefs:*** An ordered collection of references to ***JourneyPatternSections (***as ***JourneyPatternSectionRef*** instances), that contain the journey pattern timing links making up the ***JourneyPattern***. See ***JourneyPatternSection*** later.

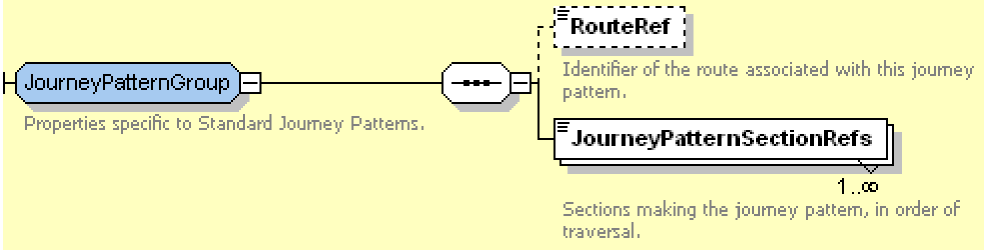

RouteRef
Identifier of the route associated with this journey pattern.
JourneyPatternGroup
Properties specific to Standard Journey Patterns.
JourneyPatternSectionRefs
1..∞
Sections making the journey pattern, in order of traversal.

Figure 6-53 – JourneyPattern / JourneyPatternGroup

6.7.4 JourneyPattern Subelements

6.7.4.1 CommonJourneyGroup JourneyPattern / Operational Element

The ***Operational*** element (*Figure 6-54*) specifies operational information associated with the JourneyPattern:

- ***Block:*** Specifies information about the operational block within which the journey is grouped.
- ***VehicleType:*** Describes the type of vehicle running a service. See below.
- ***TicketMachine:*** Information associated with service for use in ticketing machine systems. See below.

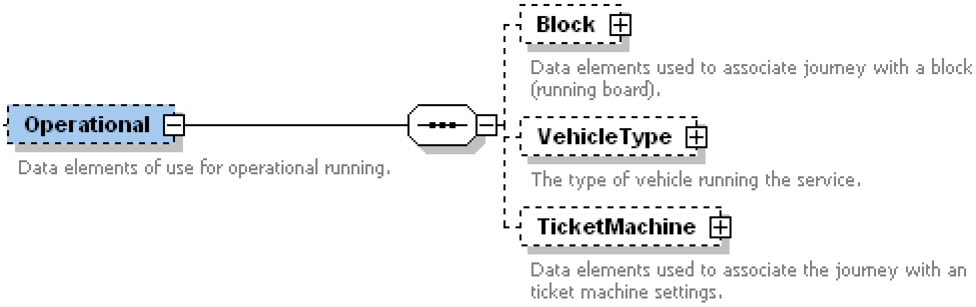

Block
Data elements used to associate journey with a block (running board).
Operational
Data elements of use for operational running.
VehicleType
The type of vehicle running the service.
TicketMachine
Data elements used to associate the journey with an ticket machine settings.

Figure 6-54 – JourneyPattern / Operational Element

6.7.4.2 CommonJourneyGroup JourneyPattern / Operational / TicketMachine Element

The ***TicketMachine*** element (*Figure 6-55*) specifies information for associating a journey with the settings of a ticket machine***.***

- ***TicketMachineServiceCode:*** Unique Identifier associated with service for use in ticketing machine systems. If not specified, defaults to any value specified at the Service Level.
- ***JourneyCode***: The identifier used by the ticket machine system to refer to the journey.
- ***Direction***: The direction used by the ticket machine system to refer to the journey.

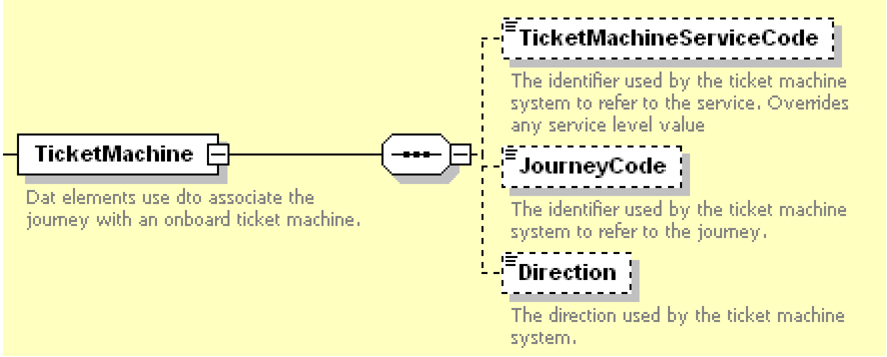

TicketMachine
Dat elements use dto associate the journey with an onboard ticket machine.
TicketMachineServiceCode
The identifier used by the ticket machine system to refer to the service. Overrides any service level value
JourneyCode
The identifier used by the ticket machine system to refer to the journey.
Direction
The direction used by the ticket machine system.

Figure 6-55 – JourneyPattern / TicketMachine Element

6.7.4.3 CommonJourneyGroup JourneyPattern / Block Element

The ***Block*** element (*Figure 6-56*) specifies information about the block (running board) of a journey. A block enables ***VehicleJourney*** instances to be assigned to a logical group of journeys that will be carried out by the same vehicle.

- ***Description***: Text describing the block.
- ***BlockNumber:*** The number of the block associated with the journey. ***VehicleJourney*** instances with the same ***BlockNumber*** will be carried out by the same vehicle
- ***Note***: Explanatory text to explaining any further operational particulars about the block.

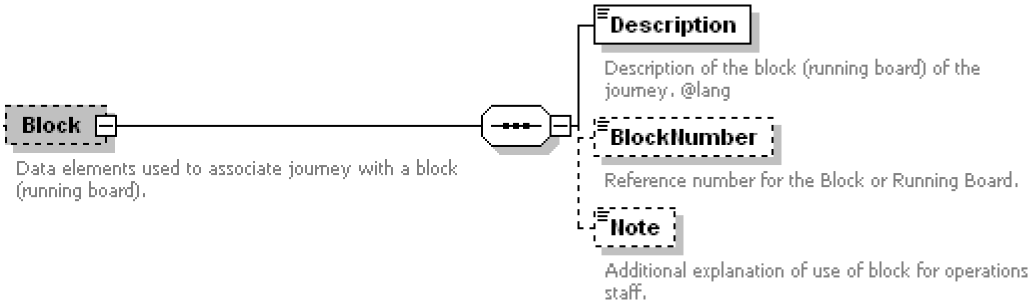

Block
Data elements used to associate journey with a block (running board).
Description
Description of the block (running board) of the journey. @lang
BlockNumber
Reference number for the Block or Running Board.
Note
Additional explanation of use of block for operations staff.

Figure 6-56 – JourneyPattern / Block Element

6.7.4.4 CommonJourneyGroup / VehicleType Element

The ***VehicleType*** element (*Figure 6-57*) describes a type of vehicle running a service.

- ***VehicleTypeCode***: Arbitrary code that classifies the vehicle.
- ***Description***: Free text description of vehicle type.

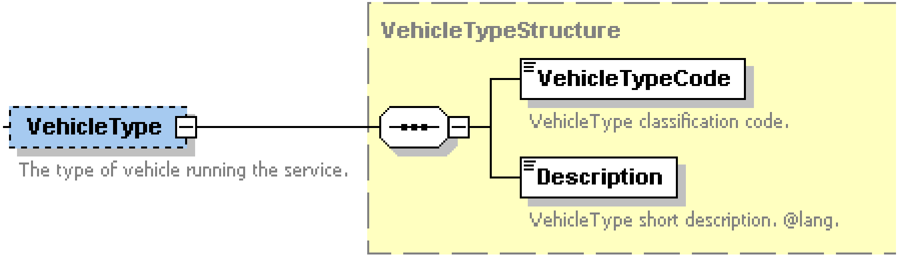

VehicleTypeStructure
VehicleType
The type of vehicle running the service.
VehicleTypeCode
VehicleType classification code.
Description
VehicleType short description. @lang.

Figure 6-57 – JourneyPattern / VehicleType Element

6.7.4.5 CommonJourneyGroup / LayoverPoint Element

The ***LayoverPoint*** element (*Figure 6-58*) describes a layover point used in a journey pattern. It is identified by an ***id*** attribute, and comprises:

- ***Duration***: Time of wait at layover point. Uses standard duration type.

- ***Name***: Free text description of layover point.
- ***Location***: Location of layover point.

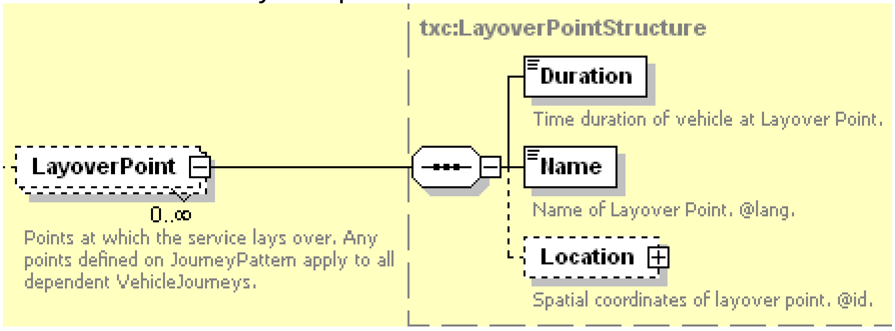

txc:LayoverPointStructure
Duration
Time duration of vehicle at Layover Point.
LayoverPoint
0..∞
Points at which the service lays over. Any points defined on JourneyPattern apply to all dependent VehicleJourneys.
Name
Name of Layover Point. @lang.
Location
Spatial coordinates of layover point. @id.

Figure 6-58 – JourneyPattern / LayoverPoint Element

6.7.5 JourneyPatternSection Element

A ***JourneyPatternSection*** (*Figure 6-59*) declares and groups an ordered collection of ***JourneyPatternTimingLink*** elements. Each ***JourneyPatternSection*** can be identified by a unique ***id*** attribute.

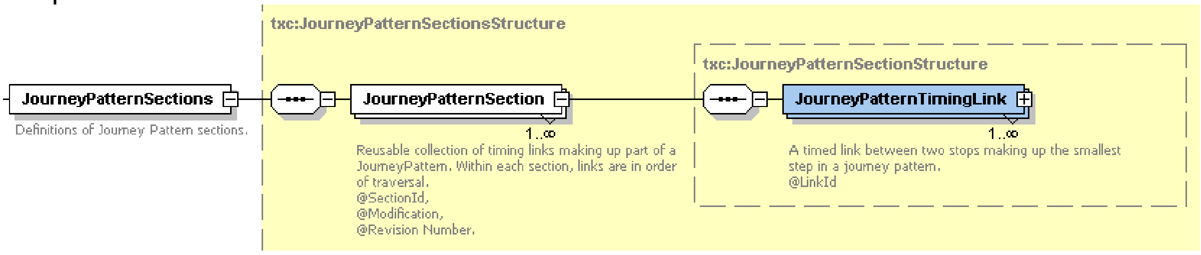

txc:JourneyPatternSectionsStructure
JourneyPatternSections
Definitions of Journey Pattern sections.
JourneyPatternSection
1..∞
Reusable collection of timing links making up part of a JourneyPattern. Within each section, links are in order of traversal.
@SectionId,
@Modification,
@Revision Number.
txc:JourneyPatternSectionStructure
JourneyPatternTimingLink
1..∞
A timed link between two stops making up the smallest step in a journey pattern.
@LinkId

Figure 6-59 – JourneyPatternSection Element

6.7.6 JourneyPatternTimingLink Element

A ***JourneyPatternTimingLink*** (*Figure 6-60*) describes a timed link connecting two stops of a ***JourneyPattern*** of a ***StandardService.*** Each ***JourneyPatternTimingLink*** can be identified by a unique ***id*** attribute, and comprises a number of elements falling into two groups:

1. ***CommonTimingLinkGroup:*** Shared elements common to journey pattern timing links and to vehicle journey timing links.
2. ***JourneyPatternTimingLinkGroup:*** Elements specific to journey pattern timing links.

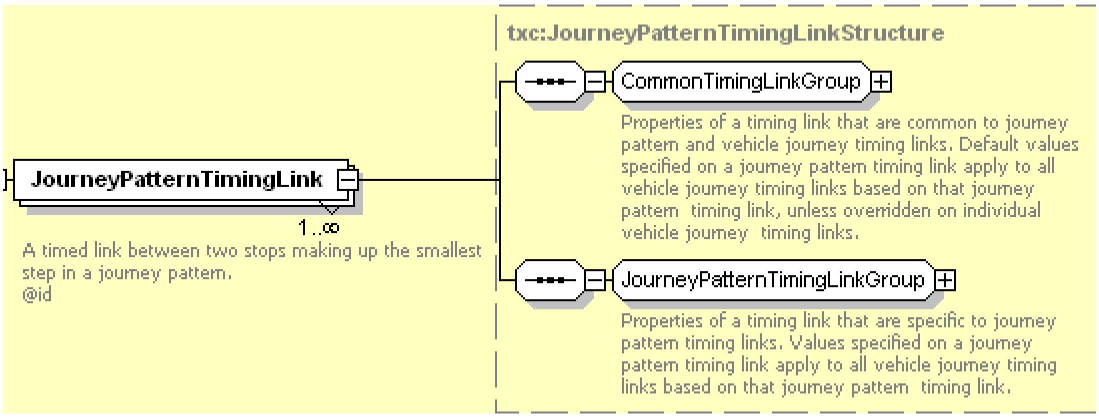

txc:JourneyPatternTimingLinkStructure
CommonTimingLinkGroup
Properties of a timing link that are common to journey pattern and vehicle journey timing links. Default values specified on a journey pattern timing link apply to all vehicle journey timing links based on that journey pattern timing link, unless overridden on individual vehicle journey timing links.
JourneyPatternTimingLink
1..∞
A timed link between two stops making up the smallest step in a journey pattern.
@id
JourneyPatternTimingLinkGroup
Properties of a timing link that are specific to journey pattern timing links. Values specified on a journey pattern timing link apply to all vehicle journey timing links based on that journey pattern timing link.

Figure 6-60 – JourneyPatternTimingLink Element

6.7.6.1 JourneyPatternTimingLink / CommonTimingLinkGroup

The ***CommonTimingLinkGroup*** (*Figure 6-62*) holds elements that are common to both a ***JourneyPatternTimingLink*** and a ***VehicleJourneyTimingLink;*** the ***JourneyPatternTimingLink*** instances provide default values to use on dependent ***VehicleJourneyTimingLink*** instances if no specific override is provided on a particular ***VehicleJourneyTimingLink***.

- ***HailAndRide:*** Whether link operates as a Hail and Ride service. Normally stops at both ends of a link flagged as ***HailAndRide*** will be ***HailAndRide*** stops.
- ***Express:*** Whether link operates as an express section (that is, typically going past a stop without stopping at one or both ends of the link).
- ***StoppingArrangements*** Text description of facilities/requirements for stopping associated with link.
- ***DutyCrewCode:*** Code identifying duty crew operating bus over link. Note that if used, a value need not be specified on every link of a journey pattern: any value specified is assumed to run for all intervening links until the next link with a value is encountered.

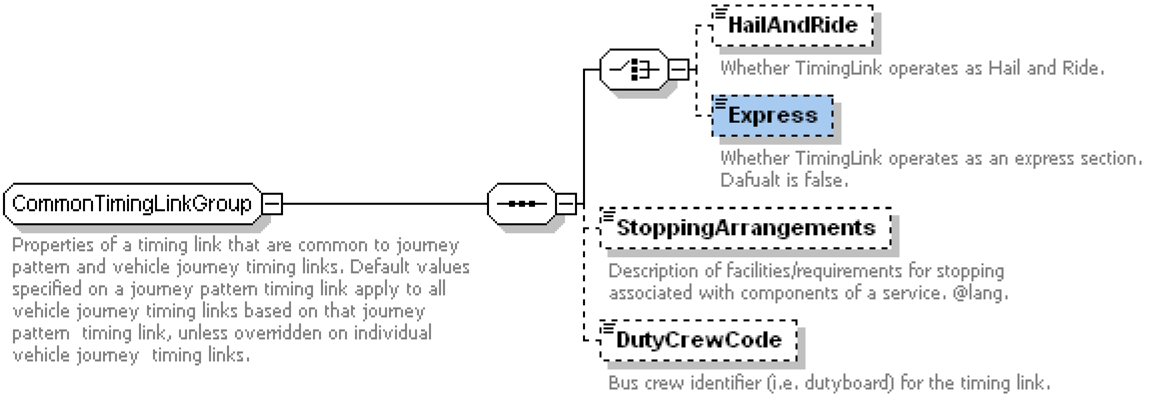

HailAndRide
Whether TimingLink operates as Hail and Ride.
Express
Whether TimingLink operates as an express section. Dafualt is false.
CommonTimingLinkGroup
Properties of a timing link that are common to journey pattern and vehicle journey timing links. Default values specified on a journey pattern timing link apply to all vehicle journey timing links based on that journey pattern timing link, unless overridden on individual vehicle journey timing links.
StoppingArrangements
Description of facilities/requirements for stopping associated with components of a service. @lang.
DutyCrewCode
Bus crew identifier (i.e. dutyboard) for the timing link.

Figure 6-61 – JourneyPatternTimingLink / CommonTimingLinkGroup

6.7.6.2 JourneyPatternTimingLink / JourneyPatternTimingLinkGroup

The ***JourneyPatternTimingLinkGroup*** (*Figure 6-62*) holds elements that are specific to a ***JourneyPatternTimingLink:***

- ***From:*** Default usage details of from stop, specified by a ***JourneyPatternStopUsageStructure.*** See later.
- ***To:*** Default usage details of from stop, specified by a ***JourneyPatternStopUsageStructure*** element. See later.
- ***RouteLinkRef:*** Optional reference to a ***RouteLink*** onto which timing link projects.
- ***Direction:*** Direction of link. Default is '*inherit*'. See *Table 6-15.*
- ***RunTime:*** Time taken to traverse link. Normally this will be greater than zero.

Value	Description
inherit	Use value from Journey Pattern.
inbound	Inbound Direction.
outbound	Outbound Direction.
clockwise	Clockwise Direction.
antiClockwise	Anti-Clockwise Direction.

Table 6-15 – Allowed Values for VehicleJourney / Direction

- ***Distance:*** Distance along link path in metres.

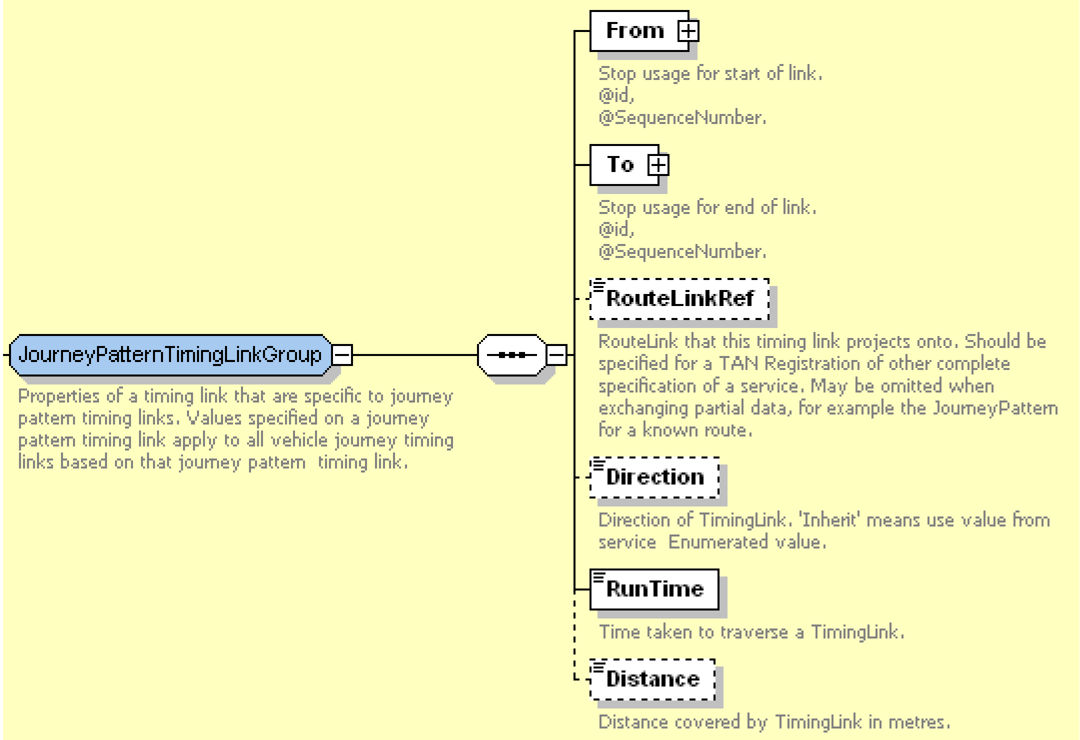

From
Stop usage for start of link.
@id,
@SequenceNumber.
To
Stop usage for end of link.
@id,
@SequenceNumber.
RouteLinkRef
RouteLink that this timing link projects onto. Should be specified for a TAN Registration of other complete specification of a service. May be omitted when exchanging partial data, for example the JourneyPattern for a known route.
JourneyPatternTimingLinkGroup
Properties of a timing link that are specific to journey pattern timing links. Values specified on a journey pattern timing link apply to all vehicle journey timing links based on that journey pattern timing link.
Direction
Direction of TimingLink. 'Inherit' means use value from service Enumerated value.
RunTime
Time taken to traverse a TimingLink.
Distance
Distance covered by TimingLink in metres.

Figure 6-62 – JourneyPatternTimingLink / JourneyPatternTimingLinkGroup

6.7.7 JourneyPatternStopUsageStructure

The ***JourneyPatternStopUsageStructure*** (*Figure 6-63*) describes the use of a stop by the start or end of a ***JourneyPatternTimingLink,*** or unordered stop reference in a FlexibleJourneyPattern***.*** It provides default values that will be inherited by the corresponding ***VehicleJourneyStopUsage*** elements of dependent vehicle journeys.
Both ***JourneyPatternStopUsage*** and ***VehicleJourneyStopUsage*** instances can be identified by a unique ***id*** attribute, and may also have a ***SequenceNumber*** attribute to indicate the preferred ordering of stops when presenting schedules in matrix timetable formats.
JourneyPatternStopUsage comprises a number of elements falling into two groups:

1. ***JourneyStopUsageGroup:*** Shared elements common to journey pattern stop usage elements, and to vehicle journey stop usage elements.
2. ***JourneyPatternStopUsageGroup:*** Elements specific to journey pattern stop usage elements.

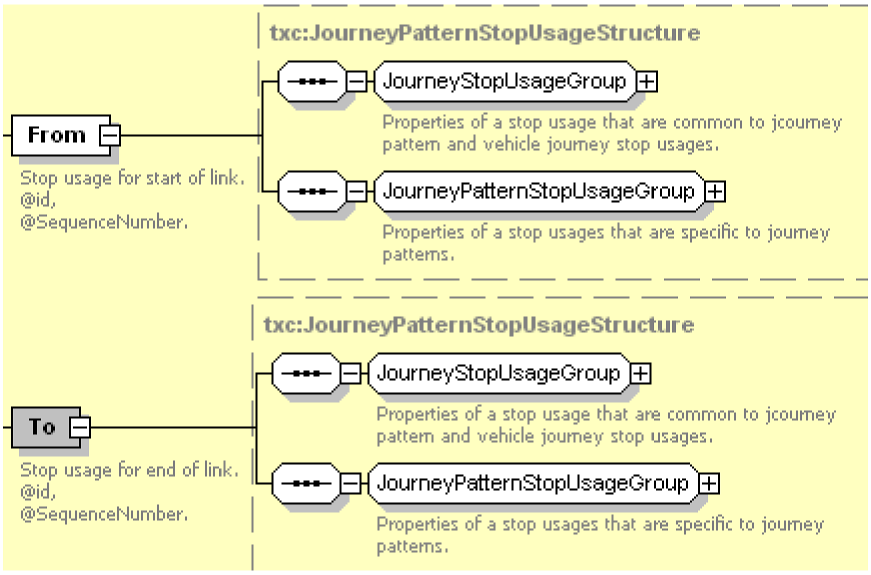

txc:JourneyPatternStopUsageStructure
JourneyStopUsageGroup
Properties of a stop usage that are common to jcourney pattern and vehicle journey stop usages.
From
Stop usage for start of link. @id, @SequenceNumber.
JourneyPatternStopUsageGroup
Properties of a stop usages that are specific to journey patterns.
txc:JourneyPatternStopUsageStructure
JourneyStopUsageGroup
Properties of a stop usage that are common to jcourney pattern and vehicle journey stop usages.
To
Stop usage for end of link. @id, @SequenceNumber.
JourneyPatternStopUsageGroup
Properties of a stop usages that are specific to journey patterns.

Figure 6-63 – JourneyPattern / JourneyPatternStopUsageStructure

6.7.7.1 JourneyPatternStopUsage / JourneyStopUsageGroup

The ***JourneyStopUsageGroup*** (*Figure 6-64*) holds elements that are common to both a ***JourneyPatternStopUsage*** and a ***VehicleJourneyStopUsage.*** Default values specified on a journey pattern stop usage apply to all vehicle journey stop usages based on that journey pattern stop usage, unless overridden on individual vehicle journey stop usages.

- ***WaitTime***: Time to wait at the referenced stop; thee wait time is the part of the *Overall Wait Time* at the stop that has been ascribed to end of the link represented by the stop usage. When calculating departure times for a specific vehicle journey, the timing link ***WaitTime*** *values* from the respective stop usage ends of the incoming and outgoing links are added together to create the total wait time at the stop. See section 3.4.3. . If not specified, assume zero.
- ***Activity***: Activity undertaken by vehicle at stop. See *Table 6-16*. Defaults to *pick up and set down*.

Value	Description
pickUp	Pick up passengers.
setDown	Set down passengers.
pickUpAndSetDown	Pick up and set down passengers.
hailAndRideStart	Start a Hail and ride section.
hailAndRideEnd	End a Hail and ride section.
pass	Do not stop at stop.

Table 6-16 – Allowed Values for Activity

- ***DynamicDestinationDisplay***: Journey destination applicable to vehicle at referenced stop.
- ***VariableStopAllocation***: In bus stations, bays may be allocated to a service variously on different days. This can be specified using the ***VariableStopAllocation*** element. See below.
- ***StopOnlyOnRequest***: Whether stop is only a request stop on this journey. Default false.
- ***Note***: Descriptive text note associated with stop.

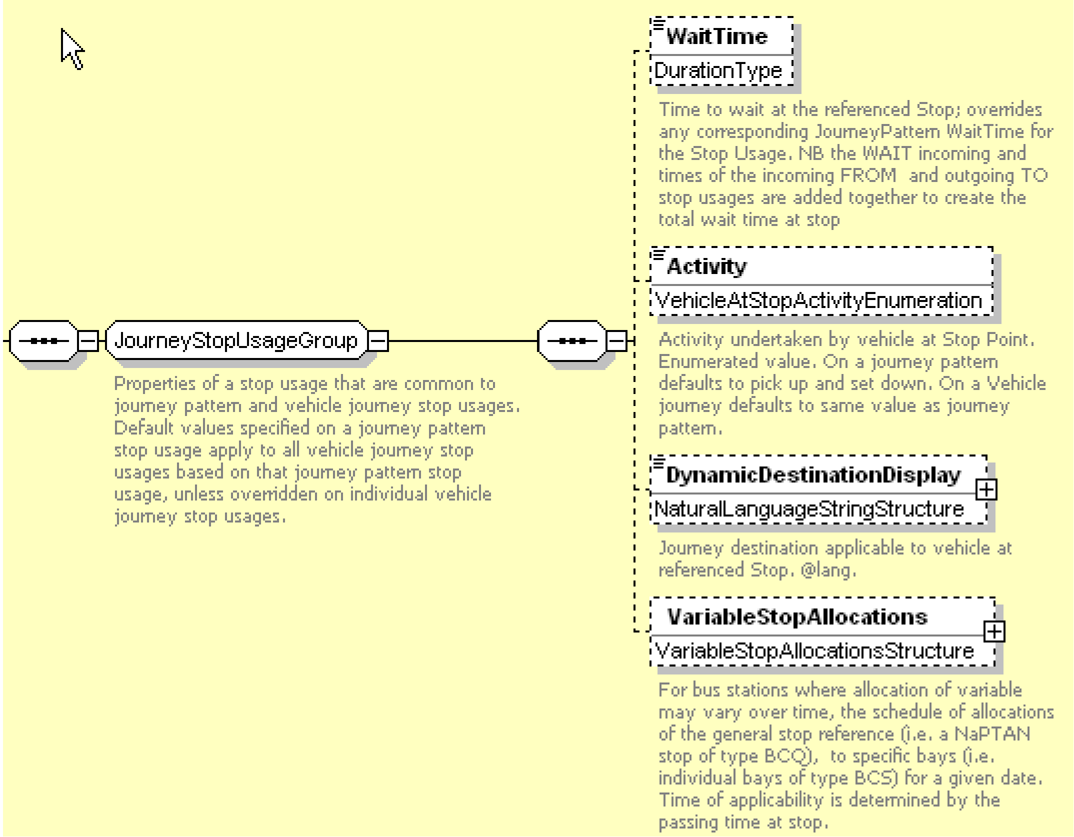

WaitTime
DurationType
Time to wait at the referenced Stop; overrides any corresponding JourneyPattern WaitTime for the Stop Usage. NB the WAIT incoming and times of the incoming FROM and outgoing TO stop usages are added together to create the total wait time at stop
Activity
VehicleAtStopActivityEnumeration
JourneyStopUsageGroup
Properties of a stop usage that are common to journey pattern and vehicle journey stop usages. Default values specified on a journey pattern stop usage apply to all vehicle journey stop usages based on that journey pattern stop usage, unless overridden on individual vehicle journey stop usages.
Activity undertaken by vehicle at Stop Point. Enumerated value. On a journey pattern defaults to pick up and set down. On a Vehicle journey defaults to same value as journey pattern.
DynamicDestinationDisplay
NaturalLanguageStringStructure
Journey destination applicable to vehicle at referenced Stop. @lang.
VariableStopAllocations
VariableStopAllocationsStructure
For bus stations where allocation of variable may vary over time, the schedule of allocations of the general stop reference (i.e. a NaPTAN stop of type BCQ), to specific bays (i.e. individual bays of type BCS) for a given date. Time of applicability is determined by the passing time at stop.

Figure 6-64 – JourneyPattern / JourneyStopUsageGroup

6.7.7.2 JourneyPatternStopUsage / JourneyPatternStopUsageGroup

The ***JourneyPatternStopUsageGroup*** (*Figure 6-65*) holds information specific to a ***JourneyPatternStopUsage:***

- ***StopPointRef***: *NaPTAN* Stop at which timing link starts or ends.
- ***TimingStatus***: Classification of the role of the stop as a timing point used by the journey pattern. See *Table 6-17*. Overrides the classification defined by the stop in *NaPTAN*.

Value	Long Value	Description
PTP	*principalTimingPoint*	Principal and time info point.
TIP	*timeInfoPoint*	Time Info Point.
OTH	*otherPoint*	Other Bus Stop.

Table 6-17 – Allowed Values for TimingStatus

- ***FareStageNumber***: The fare stage number for the referenced stop. A fare stage number should be specified if the fare stage is different from that on the previous link.
- ***FareStage***: Whether a fare stage is encountered while traversing the end of the timing link. This should correspond to the value implied by the ***FareStageNumber***. If the two are in conflict, then the ***FareStageNumber*** will be assumed to be correct.

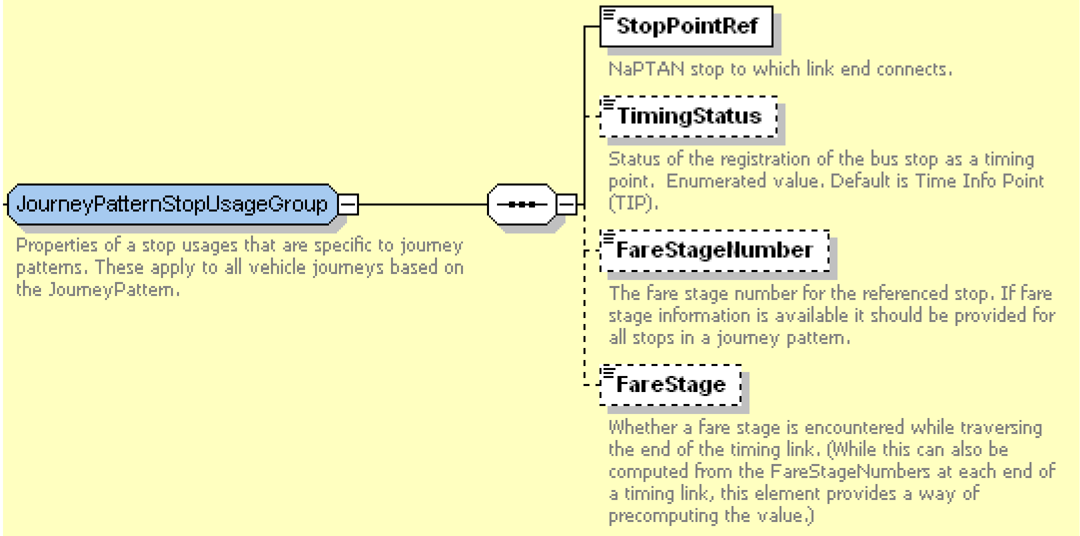

JourneyPatternStopUsageGroup
Properties of a stop usages that are specific to journey patterns. These apply to all vehicle journeys based on the JourneyPattern.
StopPointRef
NaPTAN stop to which link end connects.
TimingStatus
Status of the registration of the bus stop as a timing point. Enumerated value. Default is Time Info Point (TIP).
FareStageNumber
The fare stage number for the referenced stop. If fare stage information is available it should be provided for all stops in a journey pattern.
FareStage
Whether a fare stage is encountered while traversing the end of the timing link. (While this can also be computed from the FareStageNumbers at each end of a timing link, this element provides a way of precomputing the value.)

Figure 6-65 – JourneyPattern / JourneyPatternStopUsageGroup

6.7.7.3 VariableStopAllocations Element

The ***VariableStopAllocations*** element (*Figure 6-66*) describes the variable allocation of bays in a bus station. It can be used to assign to assign specific bays for a service on specific dates. It comprises zero or more ***VariableStopAllocation*** elements, each specifying an individual allocation on a given date. The time of allocation is the passing time of the service at the stop. Normally the assigning stop will be of stop type '*BCQ' (Bus / Coach Station Variable Bay)*, the assigned stops of type '*BCT' (Bus / Coach Station Bay)*.

- ***DateRange***: A collection of one or more open-ended date ranges, and any number of date exceptions.
  - ***StartDate***: The (inclusive) start date. If omitted, the range start is open-ended, that is, it should be interpreted as "since the beginning of the service validity period".
  - ***EndDate***: The (inclusive) end date. If omitted, the range end is open-ended, that is, it should be interpreted as "until end of the service validity period" (which may be indefinite).
- ***VariableStopPoint***: Bay or bays to which service is allocated for the specified date (and time of the service). Normally will be a *NaPTAN* stop of type '*BCT (Bus / Coach Station Bay)'*. If more than one stop is specified, then bays are considered to be a pool that can be used on a first come first serve basis.
  - ***StopPointRef***: *NaPTAN* Identifier of a ***StopPoint***.
- ***DefaultStopAllocation***: Bay or pool of bays to use if no date-specific ***VariableStopAllocation*** is applicable for a given date.

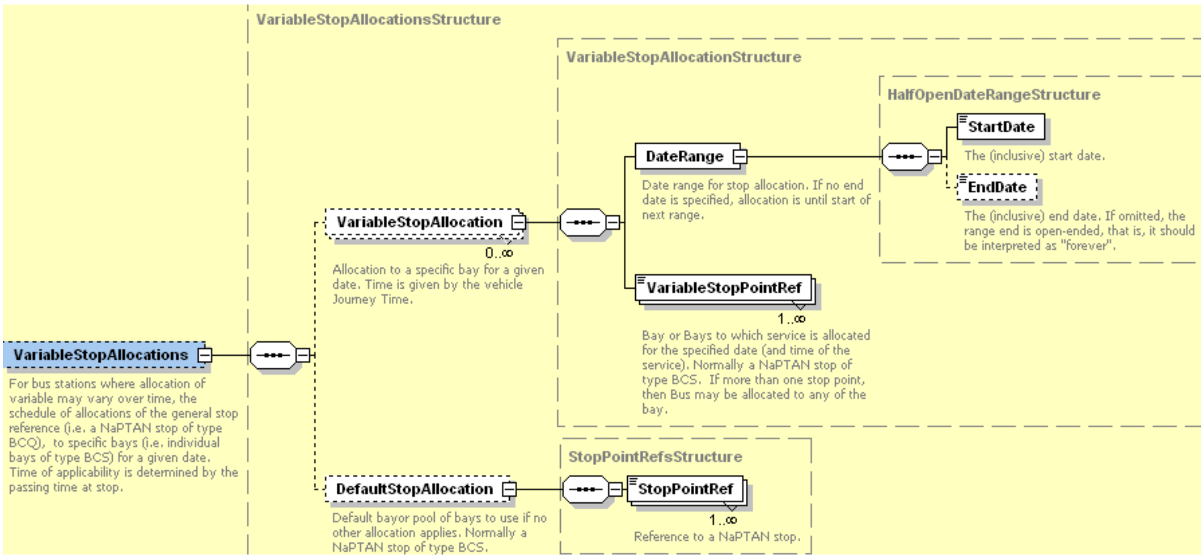

VariableStopAllocationsStructure
VariableStopAllocationStructure
HalfOpenDateRangeStructure
StartDate
The (inclusive) start date.
DateRange
EndDate
Date range for stop allocation. If no end date is specified, allocation is until start of next range.
The (inclusive) end date. If omitted, the range end is open-ended, that is, it should be interpreted as "forever".
VariableStopAllocation
0..∞
Allocation to a specific bay for a given date. Time is given by the vehicle Journey Time.
VariableStopPointRef
1..∞
Bay or Bays to which service is allocated for the specified date (and time of the service). Normally a NaPTAN stop of type BCS. If more than one stop point, then Bus may be allocated to any of the bay.
VariableStopAllocations
For bus stations where allocation of variable may vary over time, the schedule of allocations of the general stop reference (i.e. a NaPTAN stop of type BCQ), to specific bays (i.e. individual bays of type BCS) for a given date. Time of applicability is determined by the passing time at stop.
StopPointRefsStructure
DefaultStopAllocation
StopPointRef
1..∞
Default bayor pool of bays to use if no other allocation applies. Normally a NaPTAN stop of type BCS.
Reference to a NaPTAN stop.

Figure 6-66 – JourneyPattern / VariableStopAllocation Element

6.7.8 JourneyPatternInterchange Element

The ***JourneyPatternInterchange*** element (*Figure 6-67*) describes an interchange connecting two ***JourneyPatterns***. Each interchange can be identified by a unique ***id*** attribute, and comprises a number of elements, falling into two groups:

1. ***CommonInterchangeGroup:*** Shared elements common to journey pattern interchanges and vehicle journey interchanges. See below.
2. ***JourneyPatternInterchangeGroup:*** Elements specific to vehicle journey interchanges. See below.

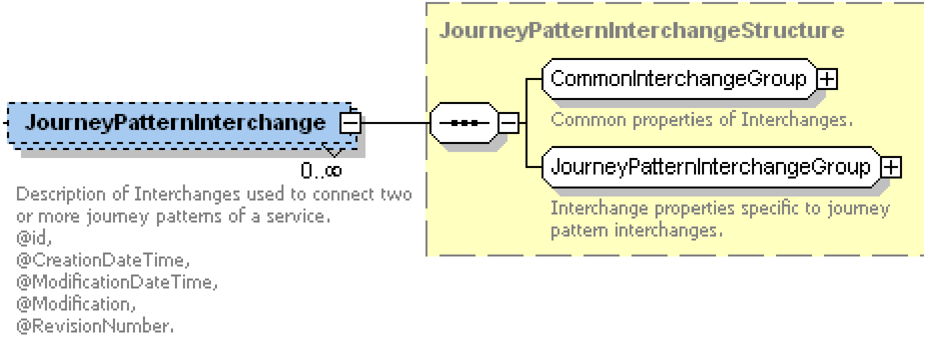

JourneyPatternInterchangeStructure
CommonInterchangeGroup
Common properties of Interchanges.
JourneyPatternInterchange
0..∞
Description of Interchanges used to connect two or more journey patterns of a service.
@id,
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.
JourneyPatternInterchangeGroup
Interchange properties specific to journey pattern interchanges.

Figure 6-67 – JourneyPatternInterchange Element

6.7.8.1 JourneyPatternInterchange / CommonInterchangeGroup

The ***CommonInterchangeGroup*** (*Figure 6-68*) holds information that is common to both a ***JourneyPatternInterchange*** and a ***VehicleJourneyInterchange.***

- ***MinInterchangeTime***: Minimum time to allow for changing services at the interchange.
- ***MaxInterchangeTime***: Maximum time that connecting service will wait at the interchange.
- ***TransferMode***: Method of transport used to make transfer between inbound and outbound journeys at the interchange. See *Table 6-18*.

Value	Description
walk	Walk transfer.
bus	Bus transfer.
train	Train transfer.
tram	Tram transfer.

metro	Metro transfer.
coach	Coach transfer.
ferry	Ferry transfer.
air	Air transfer.
taxi	Taxi transfer.
cycle	Cycle transfer.
movingWalkway	Moving Walkway transfer.

Table 6-18 – Allowed Values for TransferMode

- ***ValidityPeriod***: Period when the interchange is valid.
    - ***StartDate***: Inclusive date of start of validity period.
    - ***EndDate***: Inclusive date of end of validity period.
- ***StoppingArrangements***: Text description of stopping arrangements for the interchange.
- ***InterchangeActivity:*** Activity taking place between incoming and outgoing ***VehicleJourney*** instances at an interchange. See *Table 6-19.*
- ***InterchangeInfoGroup***: Additional information about the nature of the interchange***.*** See below.

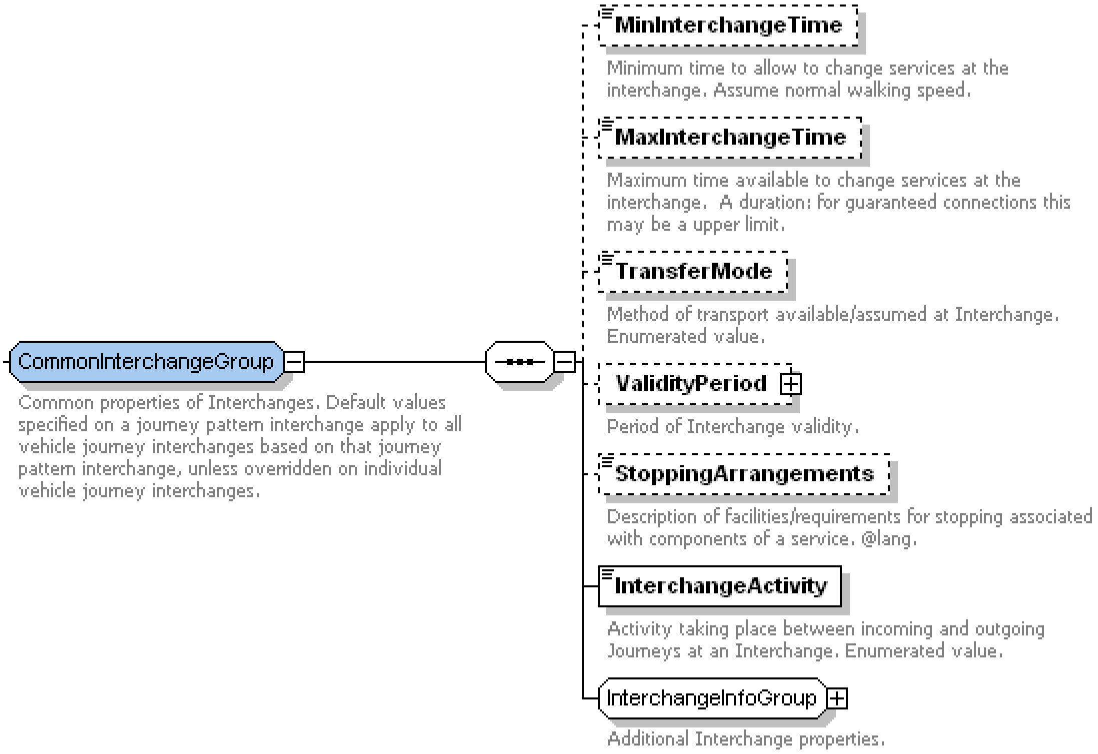

CommonInterchangeGroup
Common properties of Interchanges. Default values specified on a journey pattern interchange apply to all vehicle journey interchanges based on that journey pattern interchange, unless overridden on individual vehicle journey interchanges.
MinInterchangeTime
Minimum time to allow to change services at the interchange. Assume normal walking speed.
MaxInterchangeTime
Maximum time available to change services at the interchange. A duration: for guaranteed connections this may be a upper limit.
TransferMode
Method of transport available/assumed at Interchange. Enumerated value.
ValidityPeriod
Period of Interchange validity.
StoppingArrangements
Description of facilities/requirements for stopping associated with components of a service. @lang.
InterchangeActivity
Activity taking place between incoming and outgoing Journeys at an Interchange. Enumerated value.
InterchangeInfoGroup
Additional Interchange properties.

Figure 6-68 – CommonInterchangeGroup

6.7.8.2 JourneyPatternInterchange / InterchangeInfoGroup

The ***InterchangeInfoGroup*** (*Figure 6-69*) holds additional information about the nature of the interchange***.***

- ***CrossBorder***: Whether the connection crosses a border.
- ***GuaranteedConnection:*** Whether the connection is guaranteed.
- ***ChangeLineNumber***: Whether the service changes number at the connection.

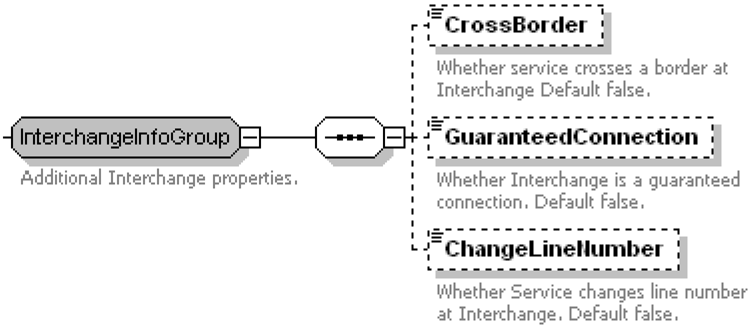

CrossBorder
Whether service crosses a border at Interchange Default false.
InterchangeInfoGroup
Additional Interchange properties.
GuaranteedConnection
Whether Interchange is a guaranteed connection. Default false.
ChangeLineNumber
Whether Service changes line number at Interchange. Default false.

Figure 6-69 – JourneyPatternInterchange / InterchangeInfoGroup

6.7.8.3 JourneyPatternInterchange / JourneyPatternInterchangeGroup

The ***JourneyPatternInterchangeGroup*** holds elements that are specific to a ***JourneyPatternInterchange,*** and describe the connection between two journeys.

- ***Inbound***
  - ***JourneyPatternRef***: Incoming ***JourneyPattern*** that connects to the interchange.
  - ***StopUsageRef***: Reference to the ***JourneyPatternStopUsage*** of the ***JourneyPatternTimingLink*** that connects inbound ***JourneyPattern*** to the interchange.
- ***Outbound***
  - ***JourneyPatternRef***: Ongoing ***JourneyPattern*** that connects from the interchange.
  - ***StopUsageRef***: Reference to the ***JourneyPatternStopUsage*** of the ***JourneyPatternTimingLink*** that connects the outbound ***JourneyPattern*** to the interchange.

Value	Description
change	Service changes at interchange
join	Service joins at interchange.
split	Service splits at interchange.
through	Through journey.

Table 6-19 – Allowed Values for InterchangeActivity

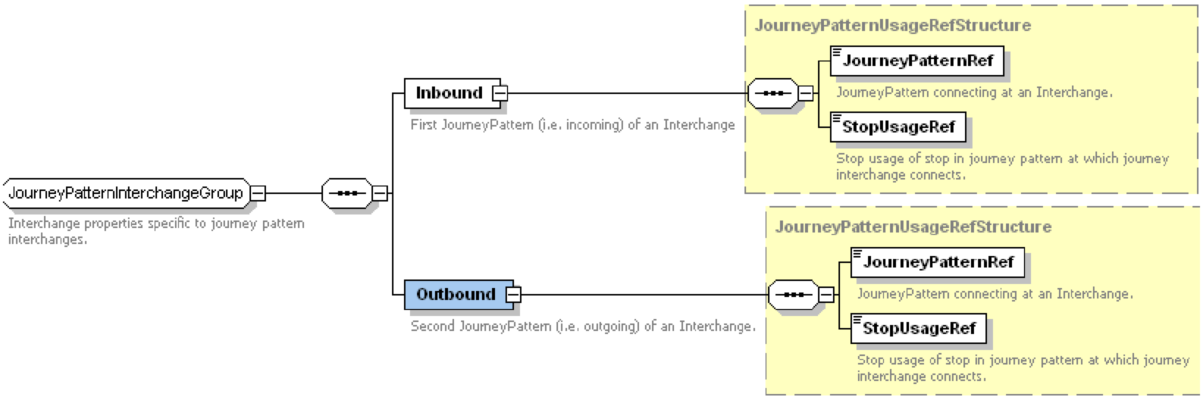

JourneyPatternUsageRefStructure
JourneyPatternRef
JourneyPattern connecting at an Interchange.
StopUsageRef
Stop usage of stop in journey pattern at which journey interchange connects.
Inbound
First JourneyPattern (i.e. incoming) of an Interchange
JourneyPatternInterchangeGroup
Interchange properties specific to journey pattern interchanges.
JourneyPatternUsageRefStructure
JourneyPatternRef
JourneyPattern connecting at an Interchange.
StopUsageRef
Stop usage of stop in journey pattern at which journey interchange connects.
Outbound
Second JourneyPattern (i.e. outgoing) of an Interchange.

Figure 6-70 – JourneyPatternInterchange / JourneyPatternInterchangeGroup

6.7.9 VehicleJourney Element

A ***VehicleJourney*** (*Figure 6-71*) describes a specific journey of a vehicle following a fixed ***JourneyPattern*** of a ***StandardService***. The ***JourneyPattern*** comprises one or more ***VehicleJourneyTimingLink*** elements: the order of links represents the order in which they are traversed. A ***VehicleJourney*** comprises a number of elements; the elements fall into three groups:

1. ***CommonJourneyGroup:*** Shared elements common to journey patterns and vehicle journeys. See ***JourneyPattern*** / ***CommonJourneyGroup*** earlier. Allows individual properties to be overridden on a vehicle journey: if not specified the property from the journey pattern will be used.
2. ***VehicleJourneyGroup:*** Elements specific to vehicle journeys, both fixed and flexible.
3. ***StandardVehicleJourneyGroup:*** Elements specific to fixed route vehicle journeys.

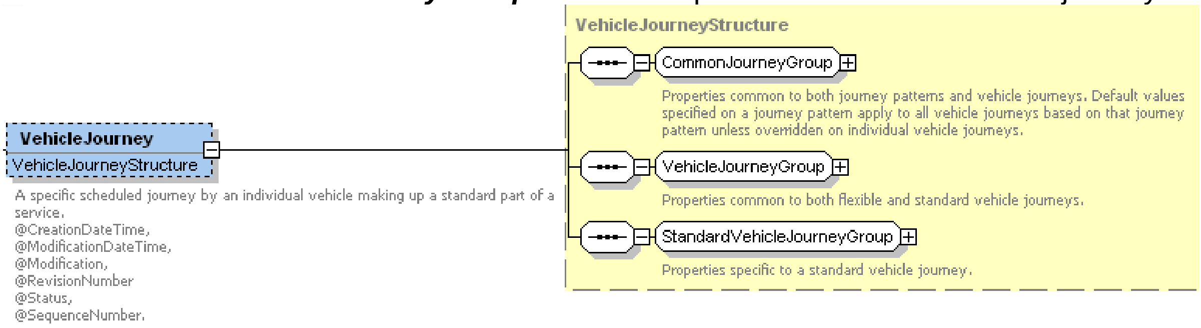

VehicleJourney
VehicleJourneyStructure
A specific scheduled journey by an individual vehicle making up a standard part of a service.
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber
@Status,
@SequenceNumber.
VehicleJourneyStructure
CommonJourneyGroup
Properties common to both journey patterns and vehicle journeys. Default values specified on a journey pattern apply to all vehicle journeys based on that journey pattern unless overridden on individual vehicle journeys.
VehicleJourneyGroup
Properties common to both flexible and standard vehicle journeys.
StandardVehicleJourneyGroup
Properties specific to a standard vehicle journey.

Figure 6-71 – VehicleJourney Element

6.7.9.1 VehicleJourney / VehicleJourneyGroup

The ***VehicleJourneyGroup*** (*Figure 6-72*): holds elements that are common to both fixed and flexible types of ***VehicleJourney.***

- ***VehicleJourneyCode***: A unique code that can be used to identify the ***VehicleJourney***.
- ***ServiceRef***: The ***Service*** to which the ***VehicleJourney*** belongs.
- ***LineRef***: The ***Service*** / ***Line*** that the ***VehicleJourney*** serves.
- Referenced Journey pattern. One of the following:
  - ***JourneyPatternRef***: The ***JourneyPattern*** over which the ***VehicleJourney*** runs. Route, timing links and other properties will be derived from the specified journey pattern.
  - ***VehicleJourneyRef***: Reuse the ***VehicleJourneyTimingLink*** elements of the referenced ***VehicleJourney***, and follow its ***JourneyPattern.*** If a ***VehicleJourneyRef*** is specified, then any ***VehicleJourneyTimingLink*** instances of the dependent ***VehicleJourney*** will be ignored.
- ***StartDeadRun:*** Initial "dead run" for positioning the vehicle before it traverses its timing links. See below.
- ***EndDeadRun:*** Final "dead run" link for positioning the vehicle after it traverses its timing links. See below.
- ***VehicleJourneyInterchange:*** Interchanges where the vehicle journey connects with another vehicle journey. See later.
- ***Note:*** Any additional notes on the ***VehicleJourney***. See below.

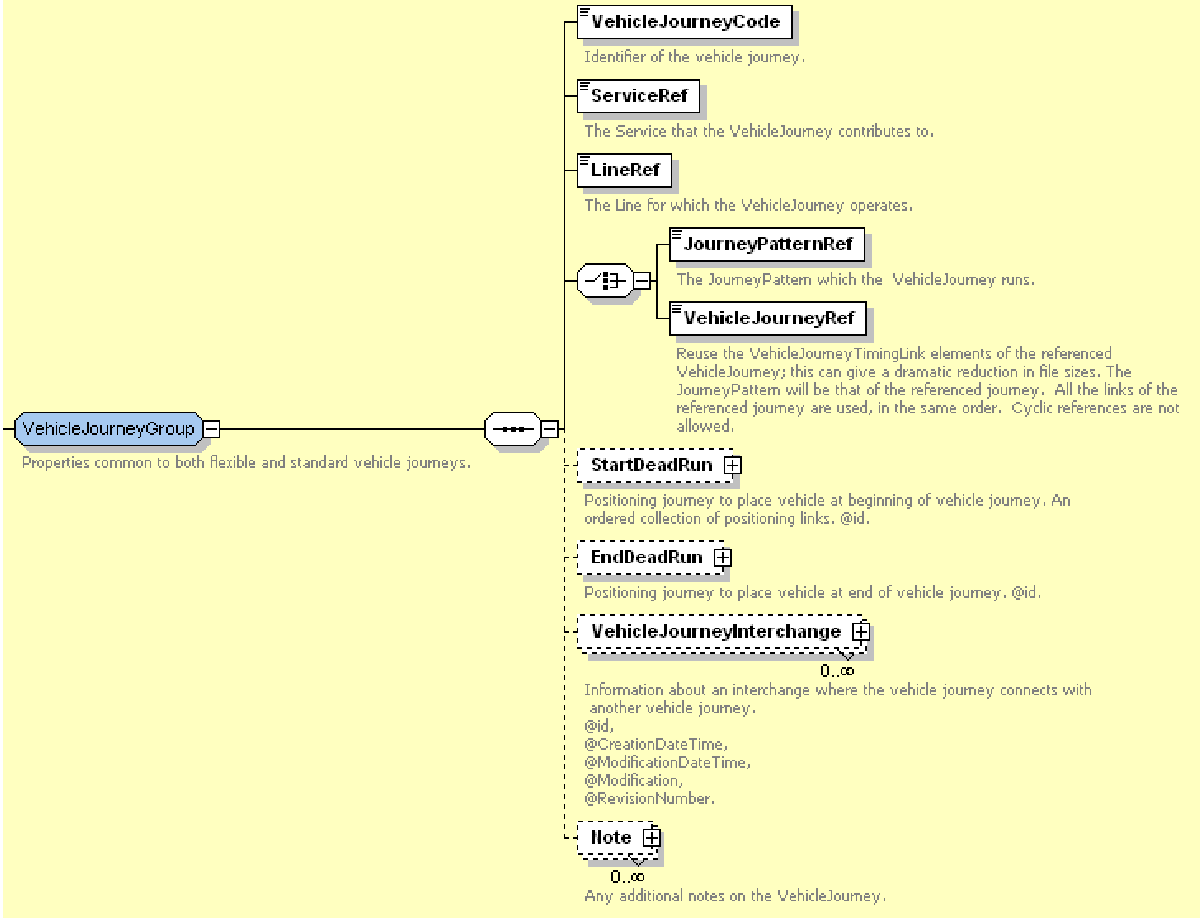

VehicleJourneyGroup
Properties common to both flexible and standard vehicle journeys.
VehicleJourneyCode
Identifier of the vehicle journey.
ServiceRef
The Service that the VehicleJourney contributes to.
LineRef
The Line for which the VehicleJourney operates.
JourneyPatternRef
The JourneyPattern which the VehicleJourney runs.
VehicleJourneyRef
Reuse the VehicleJourneyTimingLink elements of the referenced VehicleJourney; this can give a dramatic reduction in file sizes. The JourneyPattern will be that of the referenced journey. All the links of the referenced journey are used, in the same order. Cyclic references are not allowed.
StartDeadRun
Positioning journey to place vehicle at beginning of vehicle journey. An ordered collection of positioning links. @id.
EndDeadRun
Positioning journey to place vehicle at end of vehicle journey. @id.
VehicleJourneyInterchange
0..∞
Information about an interchange where the vehicle journey connects with another vehicle journey.
@id,
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.
Note
0..∞
Any additional notes on the VehicleJourney.

Figure 6-72 – VehicleJourney / VehicleJourneyGroup

6.7.9.2 VehicleJourney / StandardVehicleJourneyGroup

The ***StandardVehicleJourneyGroup*** (*Figure 6-73*) holds elements that are specific to fixed ***VehicleJourney*** instances:

- ***DepartureTime:*** Time of departure from origin stop of the ***VehicleJourney***.
- ***Frequency***: Describes service frequency for frequency based services. See below.
- ***VehicleJourneyTimingLink:*** An ordered collection of timing links making up the ***VehicleJourney***. See ***VehicleJourneyTimingLink*** later.

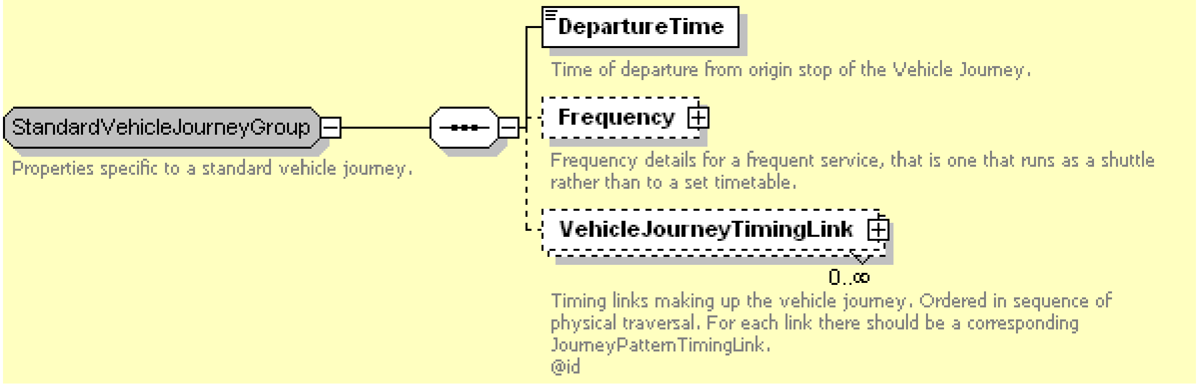

StandardVehicleJourneyGroup
Properties specific to a standard vehicle journey.
DepartureTime
Time of departure from origin stop of the Vehicle Journey.
Frequency
Frequency details for a frequent service, that is one that runs as a shuttle rather than to a set timetable.
VehicleJourneyTimingLink
0..∞
Timing links making up the vehicle journey. Ordered in sequence of physical traversal. For each link there should be a corresponding JourneyPatternTimingLink.
@id

Figure 6-73 – VehicleJourney / StandardVehicleJourneyGroup

6.7.10 Common VehicleJourney Subelements

6.7.10.1 VehicleJourney / DeadRun Element

A ***DeadRun*** (*Figure 6-74*) models a ***StartDeadRun*** or ***EndDeadRun,*** that is, a positioning run at the start or end of a journey; it is used to place a vehicle in position to start the service, or to retrieve it at the end of the journey.
It comprises:

- ***PositioningLink:*** One or more links describing how the vehicle travels to or from the route. See below.
- ***ShortWorking:*** If the dead run intercepts the journey pattern at a point, identifies the start or end point on the journey pattern at which the interception happens. May be used even if no positioning link is specified.
  - ***JourneyPatternTimingLinkRef:*** Link at which journey starts or finishes.

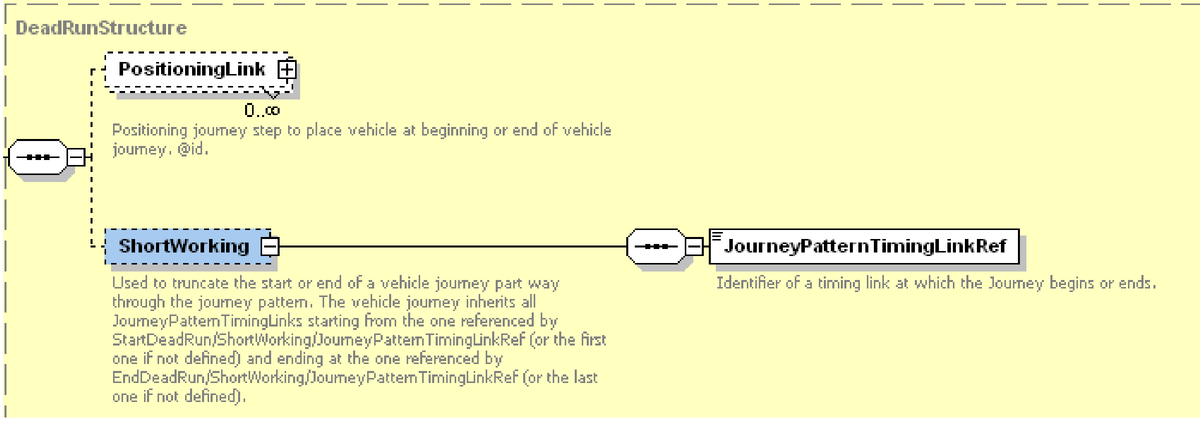

DeadRunStructure
PositioningLink
0..∞
Positioning journey step to place vehicle at beginning or end of vehicle journey. @id.
ShortWorking
Used to truncate the start or end of a vehicle journey part way through the journey pattern. The vehicle journey inherits all JourneyPatternTimingLinks starting from the one referenced by StartDeadRun/ShortWorking/JourneyPatternTimingLinkRef (or the first one if not defined) and ending at the one referenced by EndDeadRun/ShortWorking/JourneyPatternTimingLinkRef (or the last one if not defined).
JourneyPatternTimingLinkRef
Identifier of a timing link at which the Journey begins or ends.

Figure 6-74 – VehicleJourney / DeadRun Element

6.7.10.2 VehicleJourney / PositioningLink Element

A ***PositioningLink*** (*Figure 6-75*) models a step of a ***DeadRun.*** It comprises:

- ***RunTime:*** Time taken to traverse link.
- ***From:*** From point, a stop, garage, or location. See ***PositioningLinkUsage*** below.
- ***To:*** To point; also a stop, garage, or location. See ***PositioningLinkUsage*** below.
- ***Track:*** Path taken by vehicle when traversing the positioning link. See ***RouteLink / Track*** element earlier.

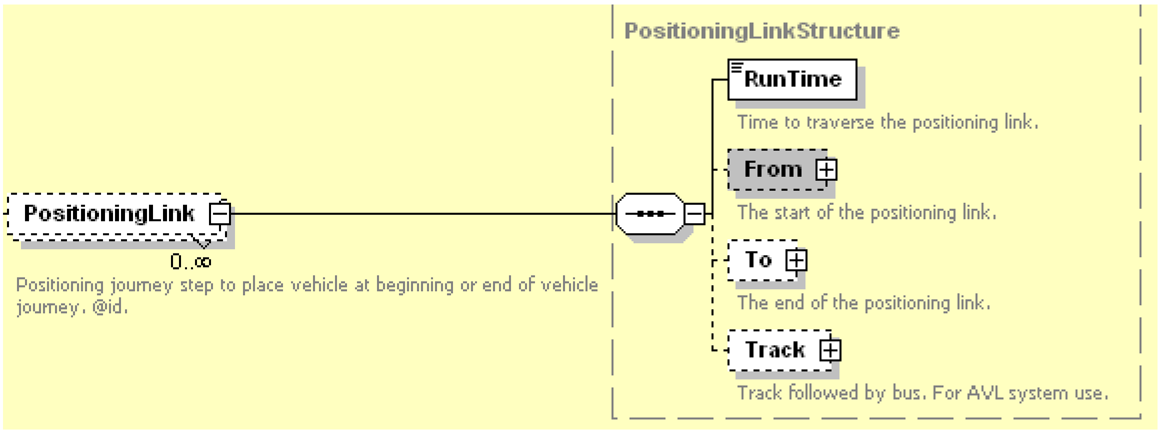

PositioningLinkStructure
RunTime
Time to traverse the positioning link.
From
The start of the positioning link.
To
The end of the positioning link.
Track
Track followed by bus. For AVL system use.
PositioningLink
0..∞
Positioning journey step to place vehicle at beginning or end of vehicle journey. @id.

Figure 6-75 – DeadRun / PositioningLink Element

6.7.10.3 VehicleJourney / PositioningLink / PositioningStopUsageStructure

A ***PositioningLinkUsage*** (*Figure 6-76*) models one end of a ***PositioningLink.*** It comprises one of the following:

- ***StopPointRef:*** A *NaPTAN* stop point. Usually on the journey pattern, but can be completely arbitrary – e.g. a stop on another route from which the bus is coming.
- ***GarageRef:*** A ***Garage*** defined for the operator of the ***Service***. to which vehicle journey belongs
- ***LayoverPointRef:*** A ***LayoverPoint*** defined for the ***JourneyPattern***.
- ***Location:*** An arbitrary location specified by spatial coordinates.

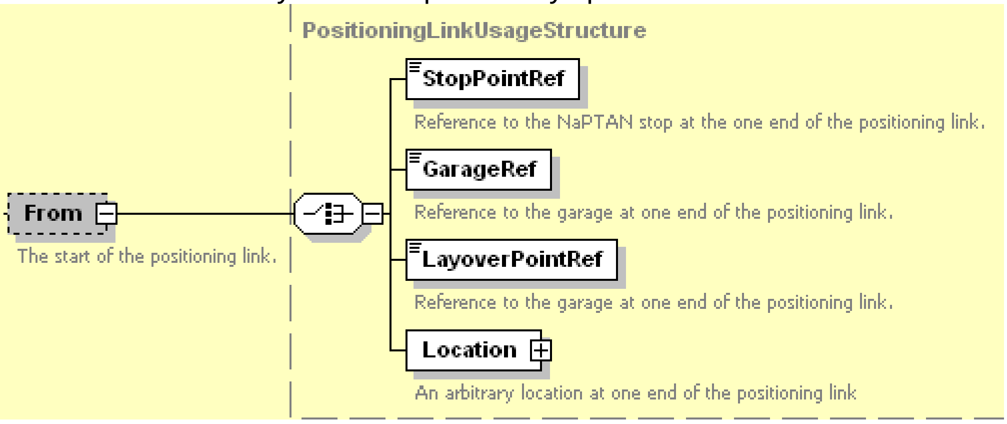

PositioningLinkUsageStructure
From
The start of the positioning link.
StopPointRef
Reference to the NaPTAN stop at the one end of the positioning link.
GarageRef
Reference to the garage at one end of the positioning link.
LayoverPointRef
Reference to the garage at one end of the positioning link.
Location
An arbitrary location at one end of the positioning link

Figure 6-76 – DeadRun / PositioningLinkUsageStructure

6.7.10.4 VehicleJourney / Frequency Element

Frequency (*Figure 6-77*) gives details about a frequency based service, that is, one that runs as a shuttle rather than to a set timetable.

- ***EndTime***: Describes when the frequency based period ends.

The frequency can be specified in one of two ways:

- ***Interval***: Describes the expected frequency of a service in quantitative terms as an interval. Comprises:
  - ***ScheduledFrequency:*** The scheduled time gap between departures.
  - ***MinimumFrequency:*** The minimum time gap between departures.
  - ***MaximumFrequency:*** The maximum time gap between.
- ***Minutes past the hour:*** Describes the expected frequency of a service in quantitative terms. Comprises:
  - ***Minutes***: One or more times past the hour.
- ***FrequentService:*** Formally declares the journey to be a frequent service, with an interval of at least once every 10 minutes. A minimum frequency should be specified.

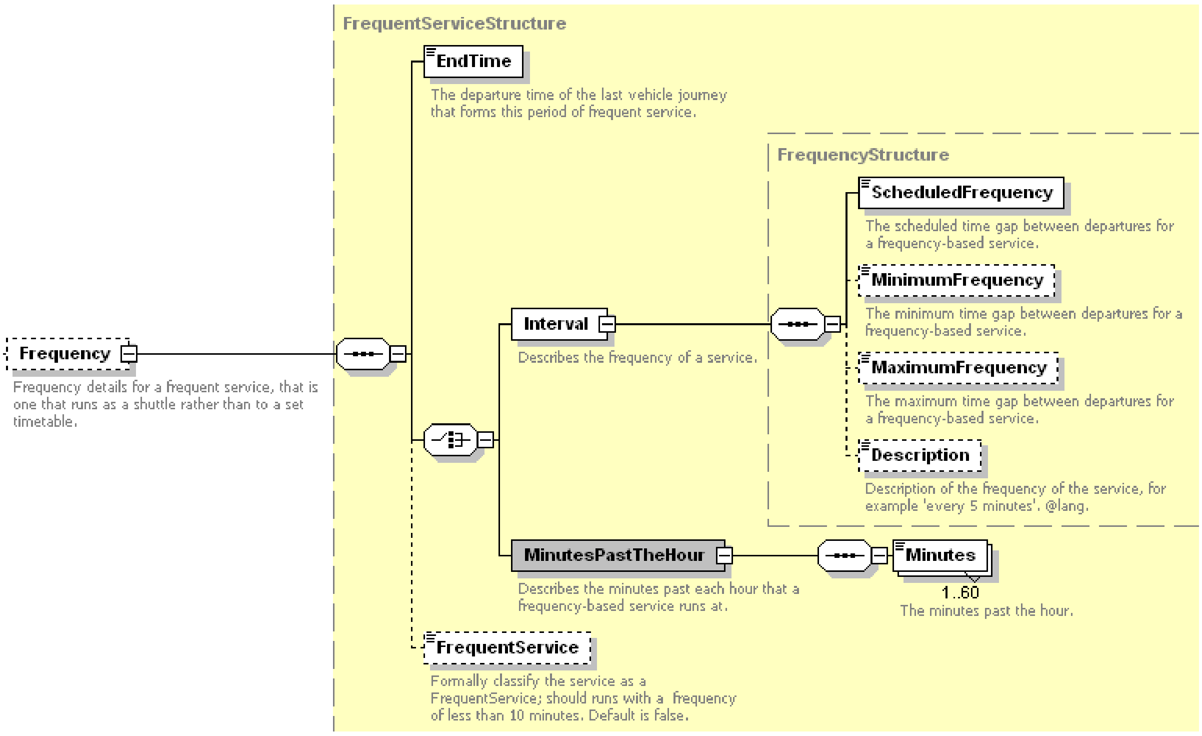

FrequentServiceStructure
EndTime
The departure time of the last vehicle journey that forms this period of frequent service.
FrequencyStructure
ScheduledFrequency
The scheduled time gap between departures for a frequency-based service.
MinimumFrequency
The minimum time gap between departures for a frequency-based service.
Interval
Describes the frequency of a service.
MaximumFrequency
The maximum time gap between departures for a frequency-based service.
Frequency
Frequency details for a frequent service, that is one that runs as a shuttle rather than to a set timetable.
Description
Description of the frequency of the service, for example 'every 5 minutes'. @lang.
MinutesPastTheHour
Describes the minutes past each hour that a frequency-based service runs at.
Minutes
1..60
The minutes past the hour.
FrequentService
Formally classify the service as a FrequentService; should runs with a frequency of less than 10 minutes. Default is false.

Figure 6-77 – VehicleJourney / Frequency Element

6.7.11 VehicleJourneyTimingLink Element

A ***VehicleJourneyTimingLink*** (*Figure 6-78*) models the link between two stops of a vehicle journey. Each ***VehicleJourneyTimingLink*** can be identified by a unique ***id*** attribute, and comprises a number of elements. The elements fall into two groups:

1. ***CommonTimingLinkGroup:*** Shared elements common to journey pattern timing links and vehicle journey timing links. See ***JourneyPatternTimingLink / CommonTimingLinkGroup*** earlier.
2. ***VehicleJourneyTimingLinkGroup:*** Elements specific to vehicle journey timing links.

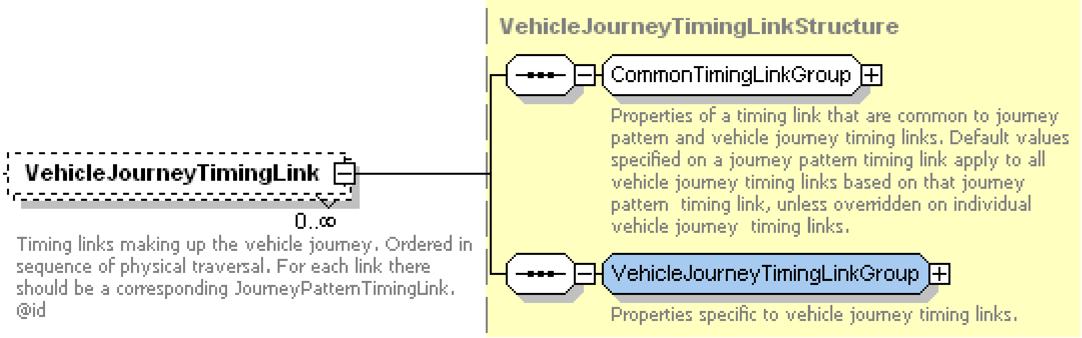

VehicleJourneyTimingLinkStructure
CommonTimingLinkGroup
Properties of a timing link that are common to journey pattern and vehicle journey timing links. Default values specified on a journey pattern timing link apply to all vehicle journey timing links based on that journey pattern timing link, unless overidden on individual vehicle journey timing links.
VehicleJourneyTimingLink
0..∞
Timing links making up the vehicle journey. Ordered in sequence of physical traversal. For each link there should be a corresponding JourneyPatternTimingLink. @id
VehicleJourneyTimingLinkGroup
Properties specific to vehicle journey timing links.

Figure 6-78 – VehicleJourneyTimingLink Element

6.7.11.1 VehicleJourneyTimingLink / VehicleJourneyTimingLinkGroup

The ***VehicleJourneyTimingLinkGroup*** (*Figure 6-79*) holds information is specific to a ***VehicleJourneyTimingLink:***

- ***JourneyPatternTimingLinkRef:*** Reference to a ***JourneyPatternTimingLink*** onto which timing link projects, and which defines the origin and destination points of the link. See ***JourneyPatternTimingLink*** earlier.

- ***RunTime:*** Time taken to traverse link. Defaults to value specified for ***JourneyPatternTimingLink***.
- ***From:*** Usage details of from stop, specified by a ***VehicleJourneyStopUsage*** element. This projects onto the ***From / JourneyPatternStopUsage*** of the corresponding ***JourneyPatternTimingLink***.
- ***To:*** Usage details of from stop, specified by a ***VehicleJourneyStopUsage*** element. This projects onto the ***To / JourneyPatternStopUsage*** of the corresponding ***JourneyPatternTimingLink.***

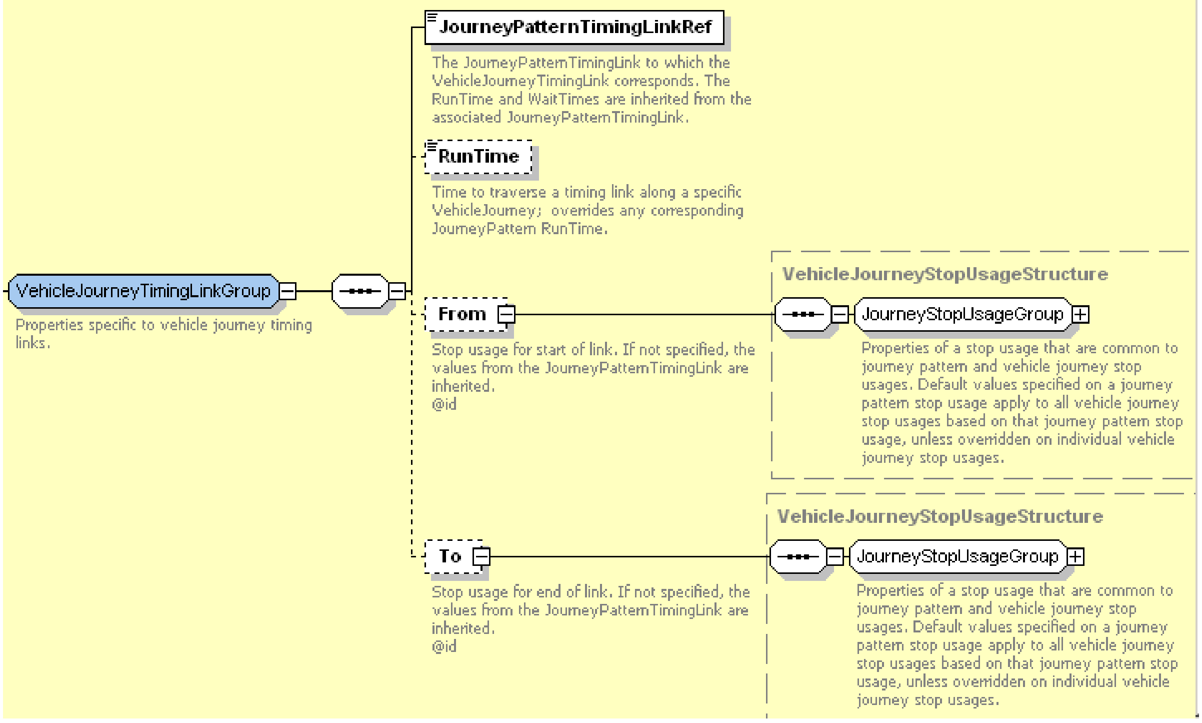

JourneyPatternTimingLinkRef
The JourneyPatternTimingLink to which the VehicleJourneyTimingLink corresponds. The RunTime and WaitTimes are inherited from the associated JourneyPatternTimingLink.
RunTime
Time to traverse a timing link along a specific VehicleJourney; overides any corresponding JourneyPattern RunTime.
VehicleJourneyTimingLinkGroup
Properties specific to vehicle journey timing links.
From
Stop usage for start of link. If not specified, the values from the JourneyPatternTimingLink are inherited.
@id
VehicleJourneyStopUsageStructure
JourneyStopUsageGroup
Properties of a stop usage that are common to journey pattern and vehicle journey stop usages. Default values specified on a journey pattern stop usage apply to all vehicle journey stop usages based on that journey pattern stop usage, unless overidden on individual vehicle journey stop usages.
To
Stop usage for end of link. If not specified, the values from the JourneyPatternTimingLink are inherited.
@id
VehicleJourneyStopUsageStructure
JourneyStopUsageGroup
Properties of a stop usage that are common to journey pattern and vehicle journey stop usages. Default values specified on a journey pattern stop usage apply to all vehicle journey stop usages based on that journey pattern stop usage, unless overidden on individual vehicle journey stop usages.

Figure 6-79 – VehicleJourneyTimingLinkGroup

6.7.12 VehicleJourneyTimingLink / VehicleJourneyStopUsage Element

The ***VehicleJourneyStopUsageStructure*** (*Figure 6-65*) describes the use of a stop by the start or end of a ***VehicleJourneyTimingLink.*** The ***VehicleJourneyStopUsage*** can be identified by a unique ***id*** attribute, and comprises a ***JourneyStopUsageGroup***: see ***JourneyPatternStopUsage*** earlier. Any values specified override the values specified for the underlying journey pattern.

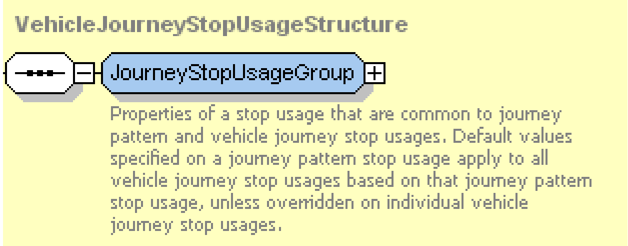

VehicleJourneyStopUsageStructure
JourneyStopUsageGroup
Properties of a stop usage that are common to journey pattern and vehicle journey stop usages. Default values specified on a journey pattern stop usage apply to all vehicle journey stop usages based on that journey pattern stop usage, unless overidden on individual vehicle journey stop usages.

Figure 6-80 – VehicleJourneyStopUsage Element

6.7.13 VehicleJourneyTimingLink / VehicleJourneyInterchange Element

The ***VehicleJourneyInterchange*** element *(Figure 6-81*) records information about an interchange at which the vehicle journey connects with another vehicle journey. Each interchange can be identified by a unique ***id*** attribute, and comprises a number of elements, falling into two groups:

1. ***CommonInterchangeGroup:*** Shared elements common to journey pattern interchange and vehicle journey interchange elements. See ***JourneyPatternInterchange*** / ***CommonInterchangeGroup*** element earlier.
2. ***VehicleJourneyInterchangeGroup:*** Elements specific to vehicle journey interchange elements. See below.

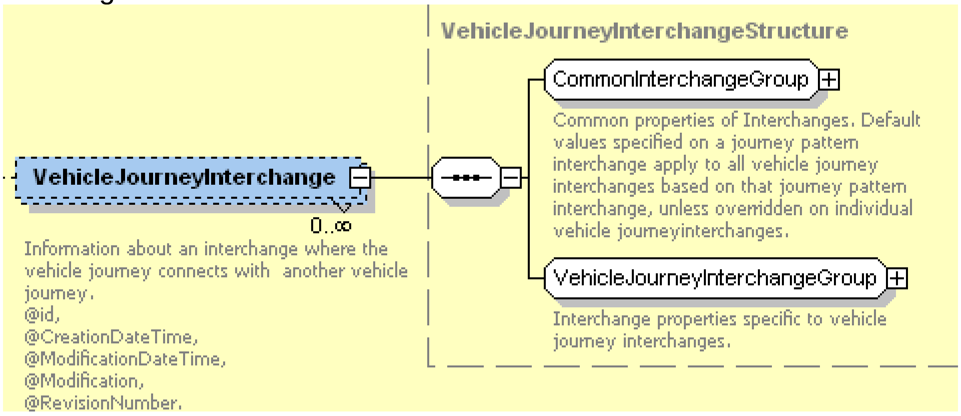

VehicleJourneyInterchangeStructure
CommonInterchangeGroup
Common properties of Interchanges. Default values specified on a journey pattern interchange apply to all vehicle journey interchanges based on that journey pattern interchange, unless overidden on individual vehicle journeyinterchanges.
VehicleJourneyInterchange
0..∞
Information about an interchange where the vehicle journey connects with another vehicle journey.
@id,
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.
VehicleJourneyInterchangeGroup
Interchange properties specific to vehicle journey interchanges.

Figure 6-81 – VehicleJourneyInterchange Element

6.7.13.1 VehicleJourneyTimingLink / VehicleJourneyInterchangeGroup

The ***VehicleJourneyInterchangeGroup*** (*Figure 6-82*) holds elements that are specific to a ***VehicleJourneyInterchange***:

- ***JourneyPatternInterchangeRef:*** The ***JourneyPatternInterchange*** to which this ***VehicleJourneyInterchange*** corresponds.
- ***InboundVehicleJourneyPatternRef***: The ***VehicleJourney*** of the incoming journey that connects at the interchange.
- ***OutboundVehicleJourneyPatternRef***: The ***VehicleJourney*** of the ongoing journey that connects at the interchange.

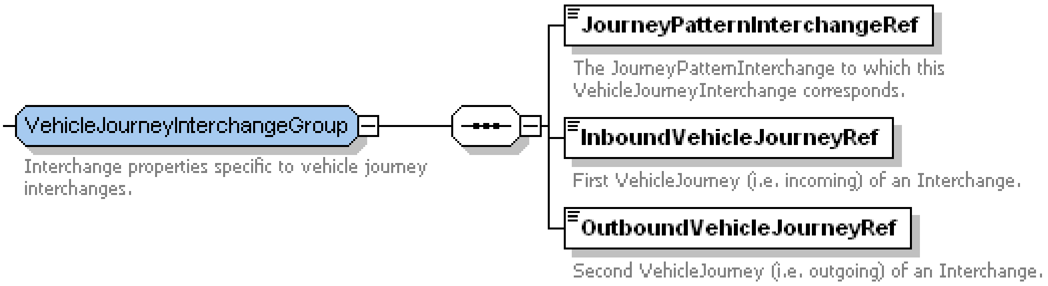

JourneyPatternInterchangeRef
The JourneyPatternInterchange to which this VehicleJourneyInterchange corresponds.
VehicleJourneyInterchangeGroup
Interchange properties specific to vehicle journey interchanges.
InboundVehicleJourneyRef
First VehicleJourney (i.e. incoming) of an Interchange.
OutboundVehicleJourneyRef
Second VehicleJourney (i.e. outgoing) of an Interchange.

Figure 6-82 – VehicleJourneyInterchangeGroup

6.8 FlexibleService, FlexibleJourneyPattern, FlexibleVehicleJourney

6.8.1 FlexibleService Element

The ***FlexibleService*** element (*Figure 6-83*) describes the flexibly routed component of a ***Service,*** using one or more ***FlexibleJourneyPattern*** instances.

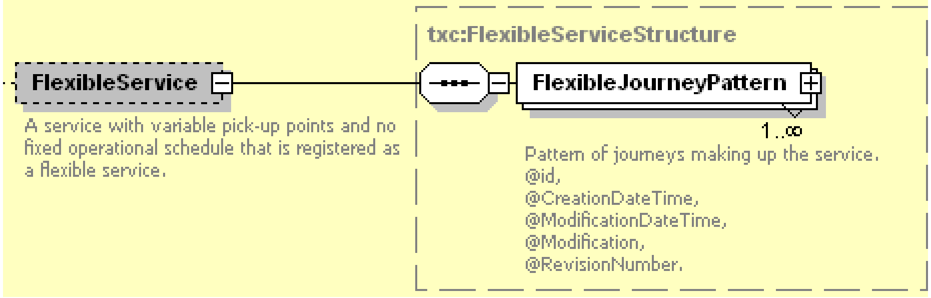

txc:FlexibleServiceStructure
FlexibleService
A service with variable pick-up points and no fixed operational schedule that is registered as a flexible service.
FlexibleJourneyPattern
1..∞
Pattern of journeys making up the service.
@id,
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.

Figure 6-83 – FlexibleService Element

6.8.1.1 FlexibleJourneyPattern Element

The ***FlexibleJourneyPattern*** element (*Figure 6-85*) describes the availability of a flexibly routed journey of a ***Service***. It is made up of two parts:

1. ***CommonJourneyGroup:*** Shared elements common to journey patterns and fixed and flexible vehicle journeys. See ***JourneyPattern / CommonJourneyGroup*** earlier. The ***JourneyPattern*** instances provide default values to use on dependent ***FlexibleVehicleJourney*** instances if no specific override is provided on an individual ***FlexibleVehicleJourney***.
2. ***FlexibleJourneyPatternGroup:*** Elements specific to flexible journey patterns.

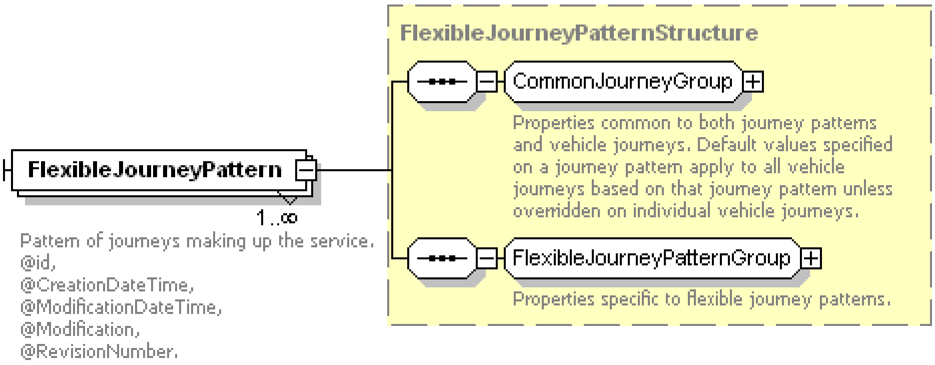

FlexibleJourneyPatternStructure
CommonJourneyGroup
Properties common to both journey patterns and vehicle journeys. Default values specified on a journey pattern apply to all vehicle journeys based on that journey pattern unless overridden on individual vehicle journeys.
FlexibleJourneyPattern
1..∞
Pattern of journeys making up the service.
@id,
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.
FlexibleJourneyPatternGroup
Properties specific to flexible journey patterns.

Figure 6-84 – FlexibleJourneyPattern Element

6.8.1.2 FlexibleJourneyPattern / FlexibleJourneyPatternGroup

The ***FlexibleJourneyPatternGroup*** (*Figure 6-85*) holds elements specific to a flexible journey pattern that describes the area of flexible operation and comprises as follows:

- ***FlexibleZones***: Describes the zones that the service covers. See ***FlexibleStopUsage*** below.
- ***FixedStopPoints***: Describes any fixed stops that can be visited by the service. See ***FixedStopUsage*** below.
- ***BookingArangements***: Arrangements for booking the service. See below.

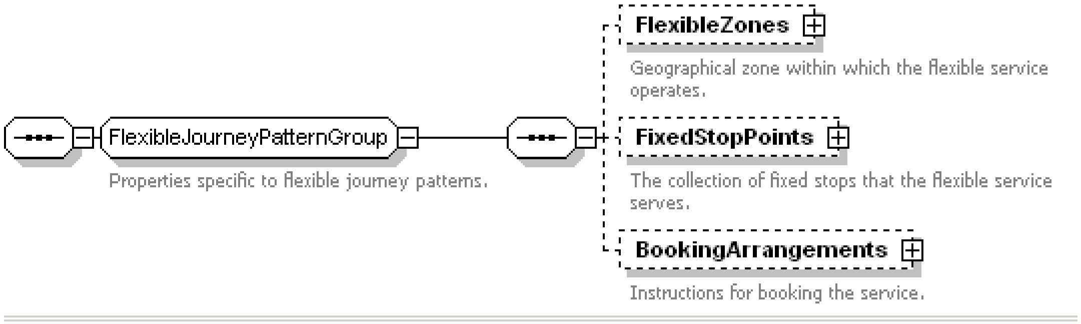

FlexibleJourneyPatternGroup
Properties specific to flexible journey patterns.
FlexibleZones
Geographical zone within which the flexible service operates.
FixedStopPoints
The collection of fixed stops that the flexible service serves.
BookingArrangements
Instructions for booking the service.

Figure 6-85 – FlexibleJourneyPattern Element

6.8.2 FlexibleService Subelements

6.8.2.1 FlexibleService / StopUsage Element

A flexible journey pattern describes the areas and stops covered by a flexible service as two lists: one of flexible zones, and one of fixed stops (*Figure 6-86*).

- ***FlexibleZones***, Comprises a collection of ***FlexibleStopUsage*** instances: each is a ***FlexibleStopUsageStructure*** (see below) instance with an activity (e.g. pick up, set down), and a reference to a *NaPTAN* stop of type ***FlexibleZone***.
- ***FixedStopPoints***: An ordered collection of ***FixedStopUsage*** instances: each is a ***JourneyPatternStopUsageStructure*** (see earlier) instance with an activity (e.g. pick up, set down), and a reference to a *NaPTAN* fixed stop, i.e. of any type ***such as MarkedPoint,*** other than ***FlexibleZone.***

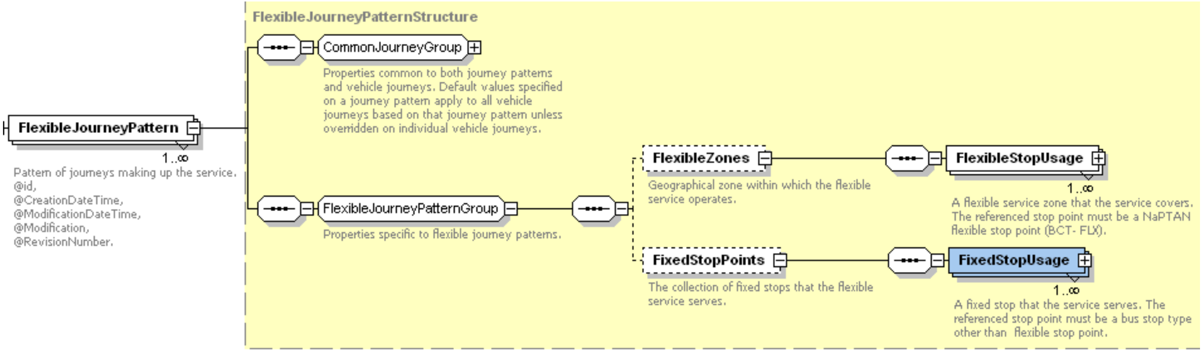

FlexibleJourneyPatternStructure
CommonJourneyGroup
Properties common to both journey patterns and vehicle journeys. Default values specified on a journey pattern apply to all vehicle journeys based on that journey pattern unless overridden on individual vehicle journeys.
FlexibleJourneyPattern
1..∞
Pattern of journeys making up the service.
@id,
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.
FlexibleJourneyPatternGroup
Properties specific to flexible journey patterns.
FlexibleZones
Geographical zone within which the flexible service operates.
FlexibleStopUsage
1..∞
A flexible service zone that the service covers. The referenced stop point must be a NaPTAN flexible stop point (BCT- FLX).
FixedStopPoints
The collection of fixed stops that the flexible service serves.
FixedStopUsage
1..∞
A fixed stop that the service serves. The referenced stop point must be a bus stop type other than flexible stop point.

Figure 6-86 – FlexibleServicePointsStructure Element

6.8.2.2 FlexibleService / FlexibleStopUsage Element

The ***FlexibleStopUsage*** element (*Figure 6-87*) describes a flexible journey stop.

- ***Activity***: Activity undertaken by vehicle at stop. See *Table 6-16*. Defaults to pick up and set down.
- ***StopPointRef***: *NaPTAN* Stop at which timing link starts or ends.

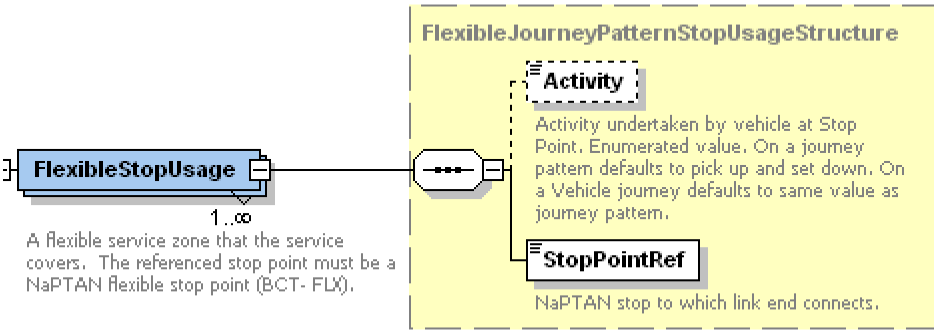

FlexibleJourneyPatternStopUsageStructure
Activity
Activity undertaken by vehicle at Stop Point. Enumerated value. On a journey pattern defaults to pick up and set down. On a Vehicle journey defaults to same value as journey pattern.
FlexibleStopUsage
1..∞
A flexible service zone that the service covers. The referenced stop point must be a NaPTAN flexible stop point (BCT- FLX).
StopPointRef
NaPTAN stop to which link end connects.

Figure 6-87 – FlexibleService / FlexibleStopUsage Element

6.8.2.3 FlexibleVehicleJourneyGroup / BookingArrangements Element

The ***BookingArrangements*** element (*Figure 6-88*) describes the booking arrangements for the flexible service:

- ***Description***: Text description of booking process.
- ***Phone***: Phone number by which to make bookings. See ***TelephoneContactStructure.***
- ***Email:*** Email address to which to make bookings.
- ***Address***: Postal address by which to make bookings. See ***PostalAddressStructure.***
- ***WebAddress:*** URL of online web site by which make bookings.
- ***AllBookingsTaken:*** Whether all bookings are taken. Default is true.

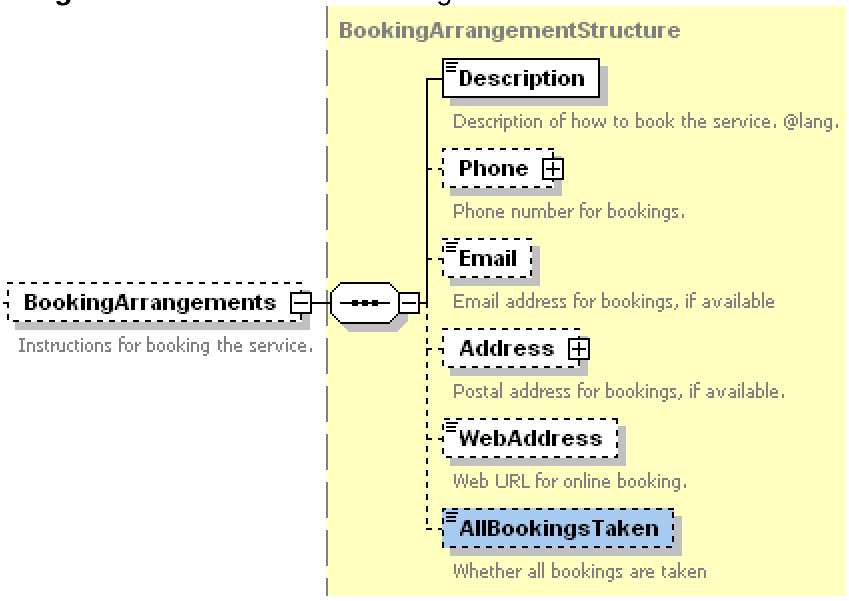

BookingArrangementStructure
Description
Description of how to book the service. @lang.
Phone
Phone number for bookings.
Email
Email address for bookings, if available
BookingArrangements
Instructions for booking the service.
Address
Postal address for bookings, if available.
WebAddress
Web URL for online booking.
AllBookingsTaken
Whether all bookings are taken

Figure 6-88 – FlexibleVehicleJourney / BookingArrangements Element

6.8.3 FlexibleVehicleJourney Element

The ***FlexibleVehicleJourney*** element (*Figure 6-89*) describes the availability of a flexible journey. It adds time information to a ***FlexibleJourneyPattern*** instance. A ***FlexibleVehicleJourney*** comprises a number of elements; the elements fall into three groups:

1. ***CommonJourneyGroup:*** Shared elements common to journey patterns and vehicle journeys (See ***JourneyPattern / CommonJourneyGroup*** earlier).
2. ***VehicleJourneyGroup:*** Elements specific to both fixed and flexible vehicle journeys (See ***VehicleJourney / VehicleJourneyGroup*** earlier).

3. ***FlexibleVehicleJourneyGroup:*** Elements specific to flexible route vehicle journeys: See ***FlexibleVehicleJourneyGroup*** / ***FlexibleServiceTimes*** below.

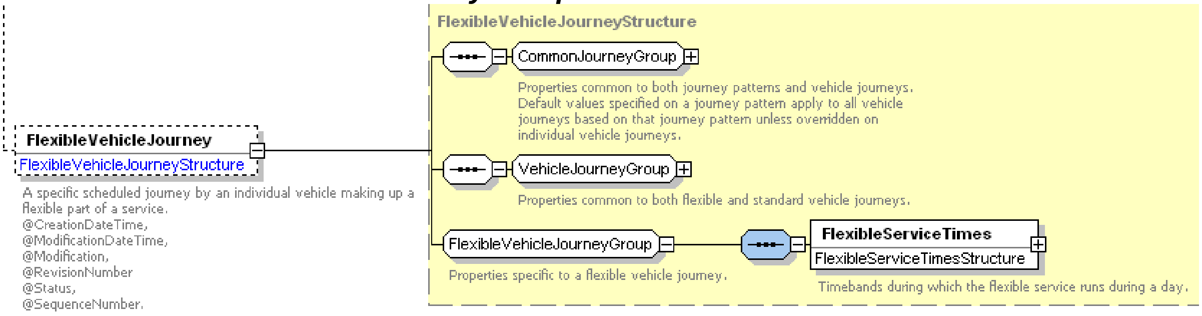

FlexibleVehicleJourneyStructure
CommonJourneyGroup
Properties common to both journey patterns and vehicle journeys. Default values specified on a journey pattern apply to all vehicle journeys based on that journey pattern unless overridden on individual vehicle journeys.
FlexibleVehicleJourney
FlexibleVehicleJourneyStructure
A specific scheduled journey by an individual vehicle making up a flexible part of a service. @CreationDateTime, @ModificationDateTime, @Modification, @RevisionNumber @Status, @SequenceNumber.
VehicleJourneyGroup
Properties common to both flexible and standard vehicle journeys.
FlexibleVehicleJourneyGroup
Properties specific to a flexible vehicle journey.
FlexibleServiceTimes
FlexibleServiceTimesStructure
Timebands during which the flexible service runs during a day.

Figure 6-89 – FlexibleVehicleJourney

6.8.3.1 FlexibleVehicleJourneyGroup / FlexibleServiceTimes Element

The ***FlexibleServiceTimes*** element (*Figure 6-90*) describes the operational days of the service.
FlexibleServiceTimes may either be:

- ***AllDayService***: Indicating the service runs all day, or
- ***PeriodsOfOperation***: A collection of at least one ***ServicePeriod*** element, made up of:
  - ***StartTime***: Time at which time band starts.
  - ***EndTime***: Time at which time band ends.

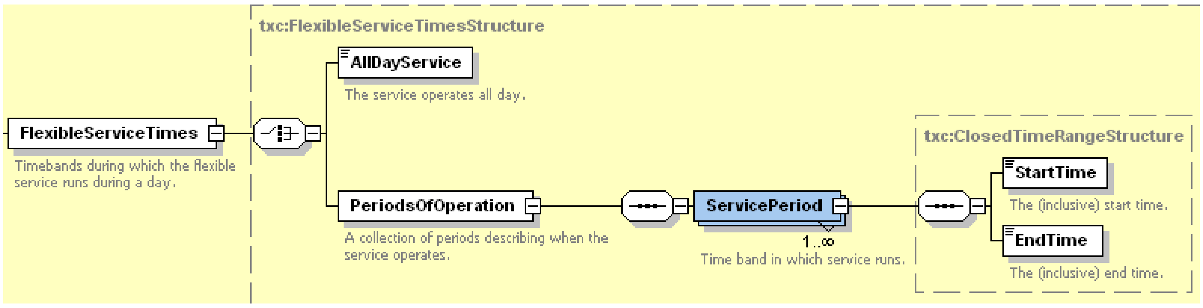

txc:FlexibleServiceTimesStructure
AllDayService
The service operates all day.
FlexibleServiceTimes
Timebands during which the flexible service runs during a day.
PeriodsOfOperation
A collection of periods describing when the service operates.
ServicePeriod
1..∞
Time band in which service runs.
txc:ClosedTimeRangeStructure
StartTime
The (inclusive) start time.
EndTime
The (inclusive) end time.

Figure 6-90 – FlexibleVehicleJourney / FlexibleServiceTimes Element

6.9 Operational Days & Times

In this section we describe the schema elements used to specify operational dates and times in *TransXChange*. These are common to both Flexible and Standard services. See also the earlier section 3.15 on *Modelling Operational days*, which sets out the rules used for combining the various day type and date elements.

6.9.1 OperatingProfile Element

The ***OperatingProfile*** element (*Figure 6-91*) specifies on which days a service operates. An ***OperatingProfile*** can be specified on both a ***VehicleJourney,*** a ***JourneyPattern*** and on a ***Service;*** the ***VehicleJourney*** values override those of the ***JourneyPattern*** or ***Service***. It is made up of two groups:

1. *Normal* operating profile group: describes normal regular behaviour.
2. *Special* operating profile group: describes behaviour on bank holidays and other exceptional days.

6.9.1.1 Normal OperatingProfileGroup

The ***OperatingProfile*** *normal* elements describe the regular operation of the service and comprise the following elements:

- ***RegularDayType:*** specifies the days on which the service normally runs. See below. Defaults to ***MondayToSunday***.
- ***PeriodicDayType:*** qualifies the ***RegularDayType*** days with any specific weeks of the month that the service runs. It is ‘anded’ with ***RegularDayType***, so that you may specify for example ‘*Wednesdays, first and third weeks of the month’*.
- ***ServicedOrganisationDayType:*** Specifies that the service runs or does not run on the working days or holidays of a nominated organisation such as a school or Local Education Authority. See ***ServicedOrganisation*** days below. ***ServicedOrganisationDayType*** is ‘anded’ with ***RegularDayType*** and any ***PeriodicDayType*** values.

6.9.1.2 Special OperatingProfileGroup

The ***OperatingProfile*** *special* elements describe exceptions to the normal days of operation and comprise the following elements:

- ***SpecialDaysOperation***: Describes the specific dates (other than standard bank holiday types) when the service will operate differently from its normal service. ***DaysOfOperation*** and ***DaysOfNonOperation*** can be specified separately. See below.
- ***BankHolidayOperation***: Describes how the service will operate on bank holidays. ***DaysOfOperation*** and ***DaysOfNonOperation*** can be specified separately. See below.

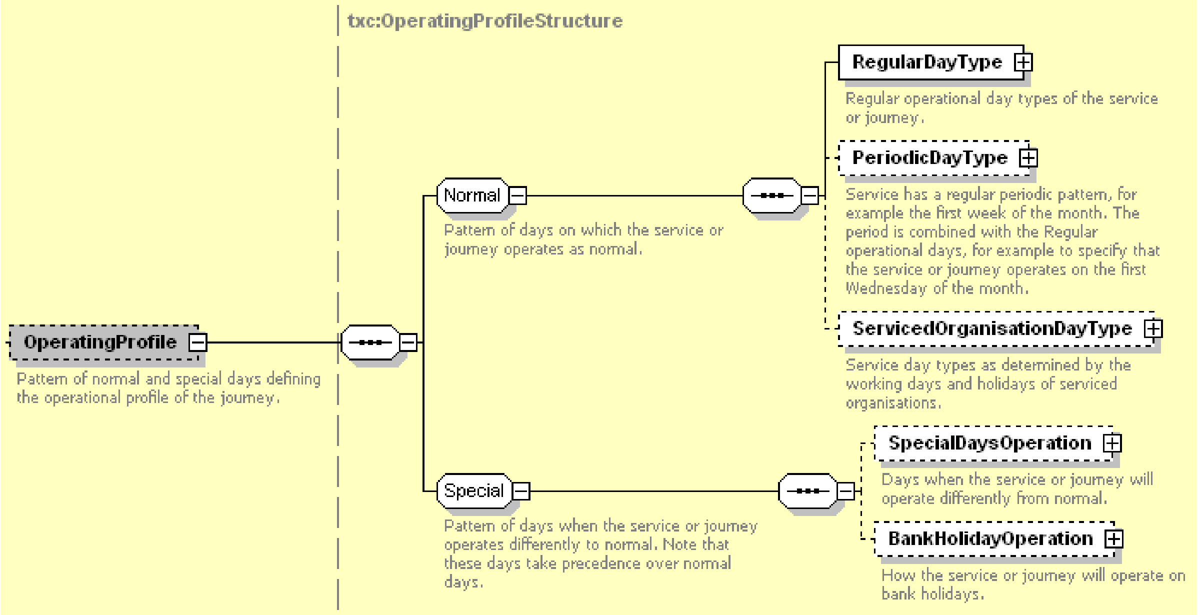

txc:OperatingProfileStructure
OperatingProfile
Pattern of normal and special days defining the operational profile of the journey.
Normal
Pattern of days on which the service or journey operates as normal.
RegularDayType
Regular operational day types of the service or journey.
PeriodicDayType
Service has a regular periodic pattern, for example the first week of the month. The period is combined with the Regular operational days, for example to specify that the service or journey operates on the first Wednesday of the month.
ServicedOrganisationDayType
Service day types as determined by the working days and holidays of serviced organisations.
Special
Pattern of days when the service or journey operates differently to normal. Note that these days take precedence over normal days.
SpecialDaysOperation
Days when the service or journey will operate differently from normal.
BankHolidayOperation
How the service or journey will operate on bank holidays.

Figure 6-91 – OperatingProfile Element

6.9.2 OperatingProfile Subelements

6.9.2.1 OperatingProfile / RegularDayType Element

The ***RegularDayType*** element (*Figure 6-92*) specifies the normal days of operation of the associated service, journey pattern or vehicle journey. It comprises either:

- ***DaysOfWeek***: Week days on which service operates. See below.
- ***HolidaysOnly***: Service only runs on holidays specified by ***OperatingProfile*** *special* elements.

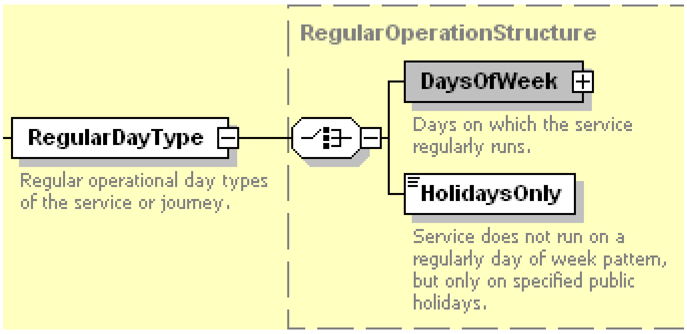

RegularOperationStructure
RegularDayType
Regular operational day types of the service or journey.
DaysOfWeek
Days on which the service regularly runs.
HolidaysOnly
Service does not run on a regularly day of week pattern, but only on specified public holidays.

Figure 6-92 – OperatingProfile / RegularDayType Element

6.9.2.2 OperatingProfile / RegularDayType / DaysOfWeek Element

The ***DaysOfWeek*** element specifies any combination of day types using a ***DayGroup*** structure (*Figure 6-93*). It allows any meaningful combination of:

- Week days:
  - ***Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday***
- Groups of days:
  - ***MondayToFriday, MondayToSaturday, MondayToSunday, NotSaturday***
  - ***Weekend:*** Saturday and Sunday.

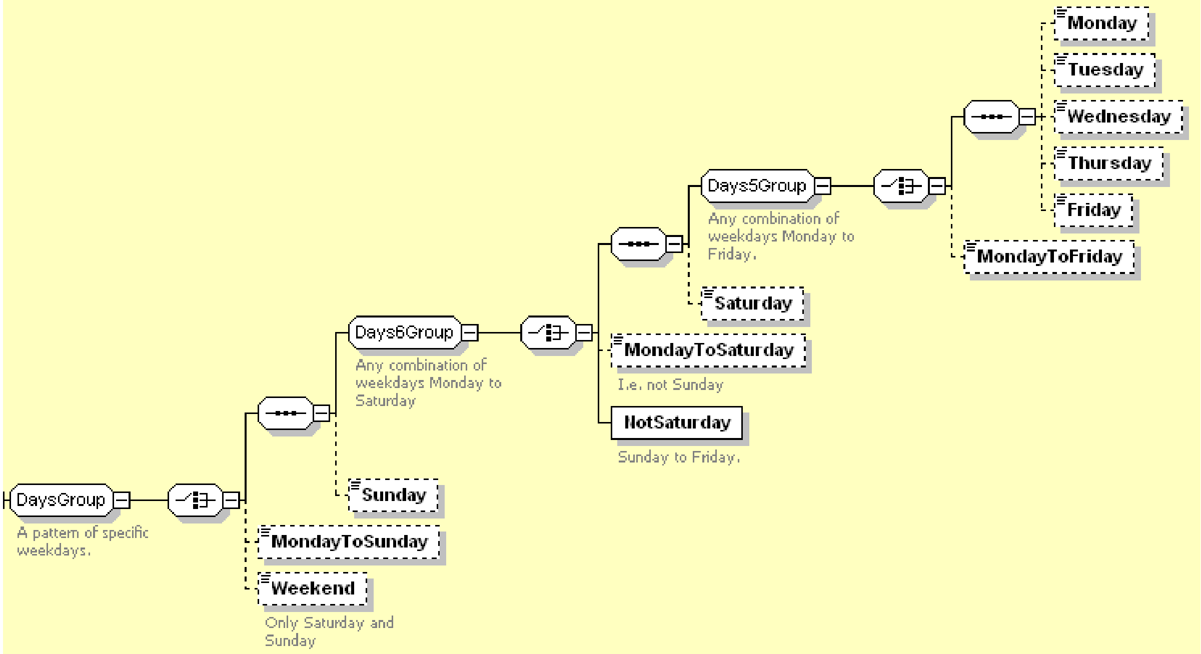


Figure 6-93 – OperatingProfile / DaysOfWeek Element

6.9.2.3 OperatingProfile / PeriodicDayType / WeekOfMonth Element

The ***PeriodicDayType / WeekOfMonth*** element (*Figure 6-94*) specifies any combination of week types within a month, using up to four ***WeekNumber*** elements, i.e. any subset of four elements out of the set of numbers 1, 2,3,4,5. The week numbers are combined with the day type, for example: *'First Wednesday in the month'*.

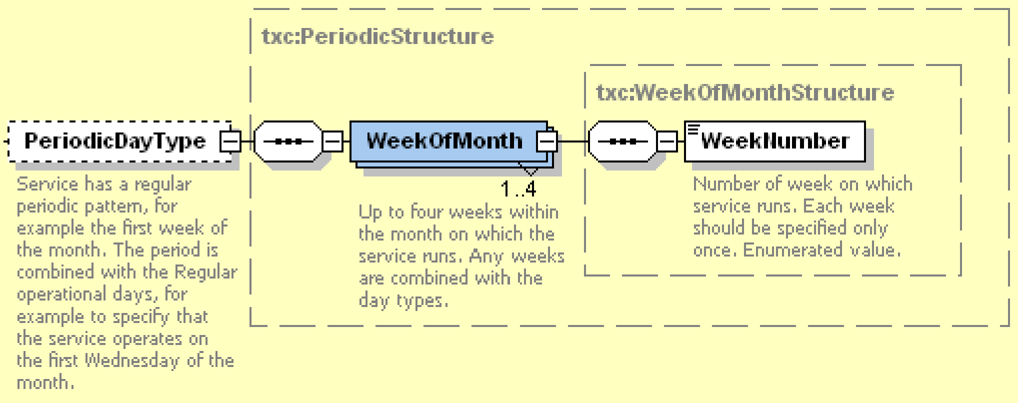

txc:PeriodicStructure
txc:WeekOfMonthStructure
PeriodicDayType
Service has a regular periodic pattern, for example the first week of the month. The period is combined with the Regular operational days, for example to specify that the service operates on the first Wednesday of the month.
WeekOfMonth
1..4
Up to four weeks within the month on which the service runs. Any weeks are combined with the day types.
WeekNumber
Number of week on which service runs. Each week should be specified only once. Enumerated value.

Figure 6-94 – OperatingProfile / WeekOfMonth Element

6.9.2.4 SpecialDaysOperation Element: DaysOfOperation, DaysOfNonOperation

The ***SpecialDaysOperation*** element (*Figure 6-95*) describes specific dates when a service does or does not operate (other than Bank Holiday day types), and comprises two collections of ***DateRange*** elements, wrapped in ***DaysOfOperation*** and ***DaysOfNonOperation*** elements respectively. If conflicting dates are specified, days of non-operation are given precedence.

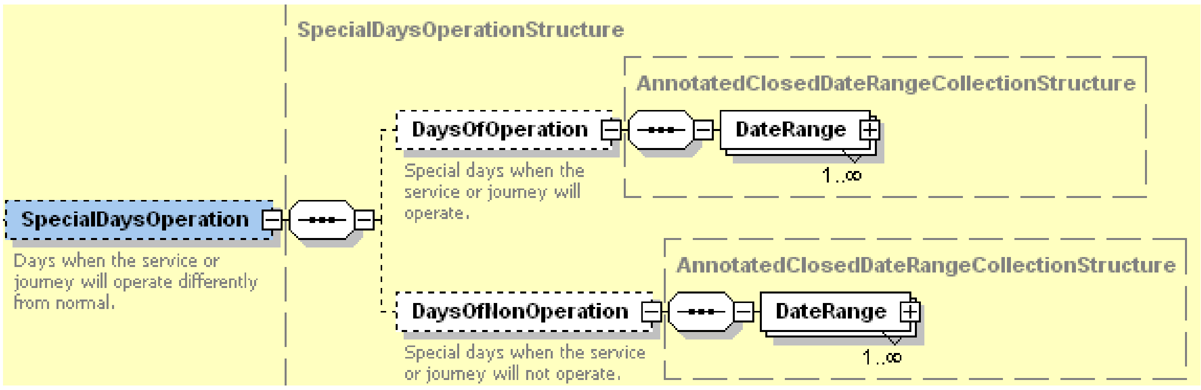

SpecialDaysOperationStructure
AnnotatedClosedDateRangeCollectionStructure
DaysOfOperation
DateRange
1..∞
Special days when the service or journey will operate.
SpecialDaysOperation
Days when the service or journey will operate differently from normal.
AnnotatedClosedDateRangeCollectionStructure
DaysOfNonOperation
DateRange
1..∞
Special days when the service or journey will not operate.

Figure 6-95 – OperatingProfile / SpecialDaysOfOperation Element

6.9.2.5 DateRange

The ***DateRange*** element (*Figure 6-96*) describes a period. Each range is specified with:

- ***StartDate:*** Inclusive date on which period starts.
- ***EndDate***: Inclusive date on which period ends.
- ***Note***: Annotation about period.

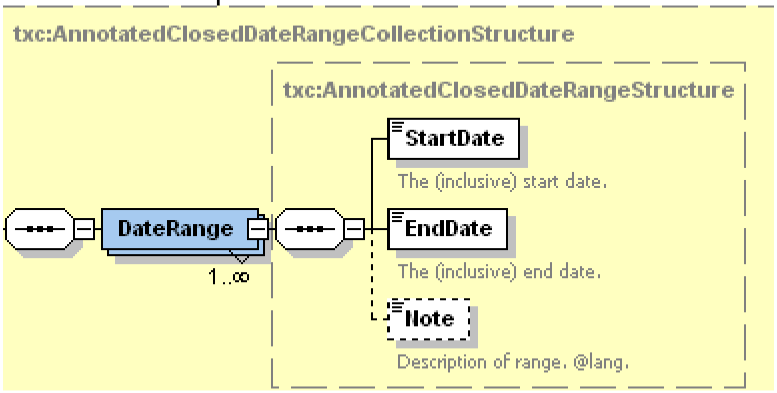

txc:AnnotatedClosedDateRangeCollectionStructure
txc:AnnotatedClosedDateRangeStructure
StartDate
The (inclusive) start date.
DateRange
1..∞
EndDate
The (inclusive) end date.
Note
Description of range. @lang.

Figure 6-96 – DateRange Element

6.9.2.6 OperatingProfile / BankHolidayOperation

The ***BankHolidayOperation*** element (*Figure 6-97***)** describes how the service does or does not operate on bank holidays, and comprises two collections of ***BankHolidayStructure*** elements, wrapped in ***DaysOfOperation*** and ***DaysOfNonOperation*** elements respectively. If conflicting dates are specified, days of non-operation are given precedence.

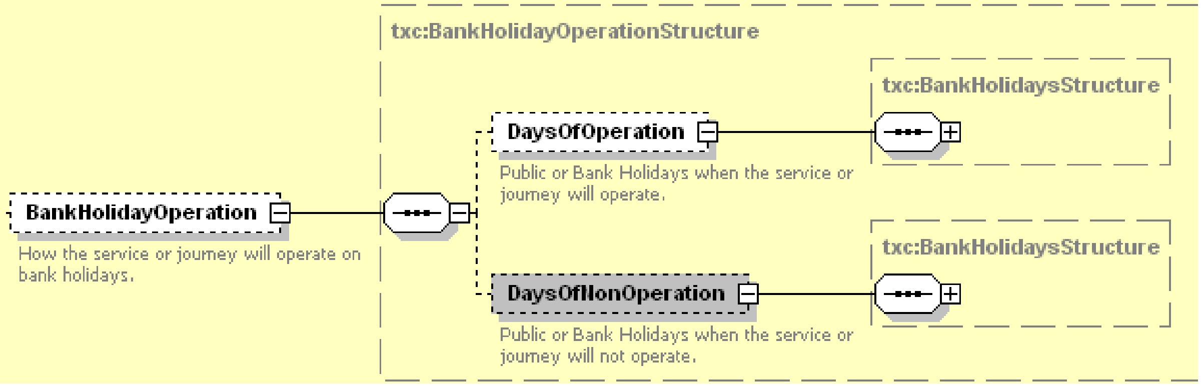

txc:BankHolidayOperationStructure
txc:BankHolidaysStructure
DaysOfOperation
Public or Bank Holidays when the service or journey will operate.
BankHolidayOperation
How the service or journey will operate on bank holidays.
txc:BankHolidaysStructure
DaysOfNonOperation
Public or Bank Holidays when the service or journey will not operate.

Figure 6-97 – OperatingProfile / BankHolidayOperation Element

6.9.2.7 OperatingProfile / BankHoliday Elements

Holiday day types are explicitly enumerated using the ***BankHolidayOperationStructure*** (see *Figure 6-98*), which allows individual holidays or combinations of holidays to be enumerated.

- Additional special holidays may be defined using ***OtherBankHoliday***.
- A special element ***AllBankHolidays*** is used to denote all Bank Holidays in the country in which the service runs. See *Table 6-20.*
    - The ***HolidayMondays*** element can be used to denote all the summer Bank holiday Mondays.
    - ***Christmas*** can be used to indicate special services for actual ***ChristmasDay*** (strictly the 25th December) and ***BoxingDay*** (strictly the 26th December).
    - The ***HolidayMondays*** element can be used to denote all the summer Bank holiday Mondays.
    - The ***AllHolidaysExceptChristmas*** element can be used to denote all the Bank holidays in the year except for ***ChristmasDay*** and ***BoxingDay***.
    - ***DisplacementHolidays*** can be used to indicate special services for Public holidays that are awarded when calendar based holidays such as Christmas Day, Boxing Day or New Year's Eve fall at a weekend so a compensating weekday, usually a Monday or Friday, is also made a public holiday. Sometimes different timetables are used for the Displacement Holiday from those that would be used for the actual day itself.
- ***EarlyRunOff*** can be used to indicate special services for Christmas and New Year's Eve.

Group		Subgroup	England & Wales	Scotland
AllBankHolidays	***AllHolidays Except Christmas***		***NewYearsDay***	***NewYearsDay***
				Jan2ndScotland
			GoodFriday	***GoodFriday***
		Holiday Mondays	***EasterMonday***	***EasterMonday***
			MayDay	***MayDay***
			SpringBank	***SpringBank***
			LateSummerHoliday NotScotland	***AugustBankHoliday Scotland***
		Christmas	***ChristmasDay***	***ChristmasDay***
			BoxingDay	***BoxingDay***
		Displacement Holidays	***ChristmasDayHoliday***	***ChristmasDayHoliday***
			BoxingDayHoliday	***BoxingDayHoliday***
			NewYearsDayHoliday	***NewYearsDayHoliday***
EarlyRunOff		-	***ChristmasEve***	***ChristmasEve***
		-	***NewYearsEve***	***NewYearsEve***

Table 6-20 – AllBankHolidays by Country

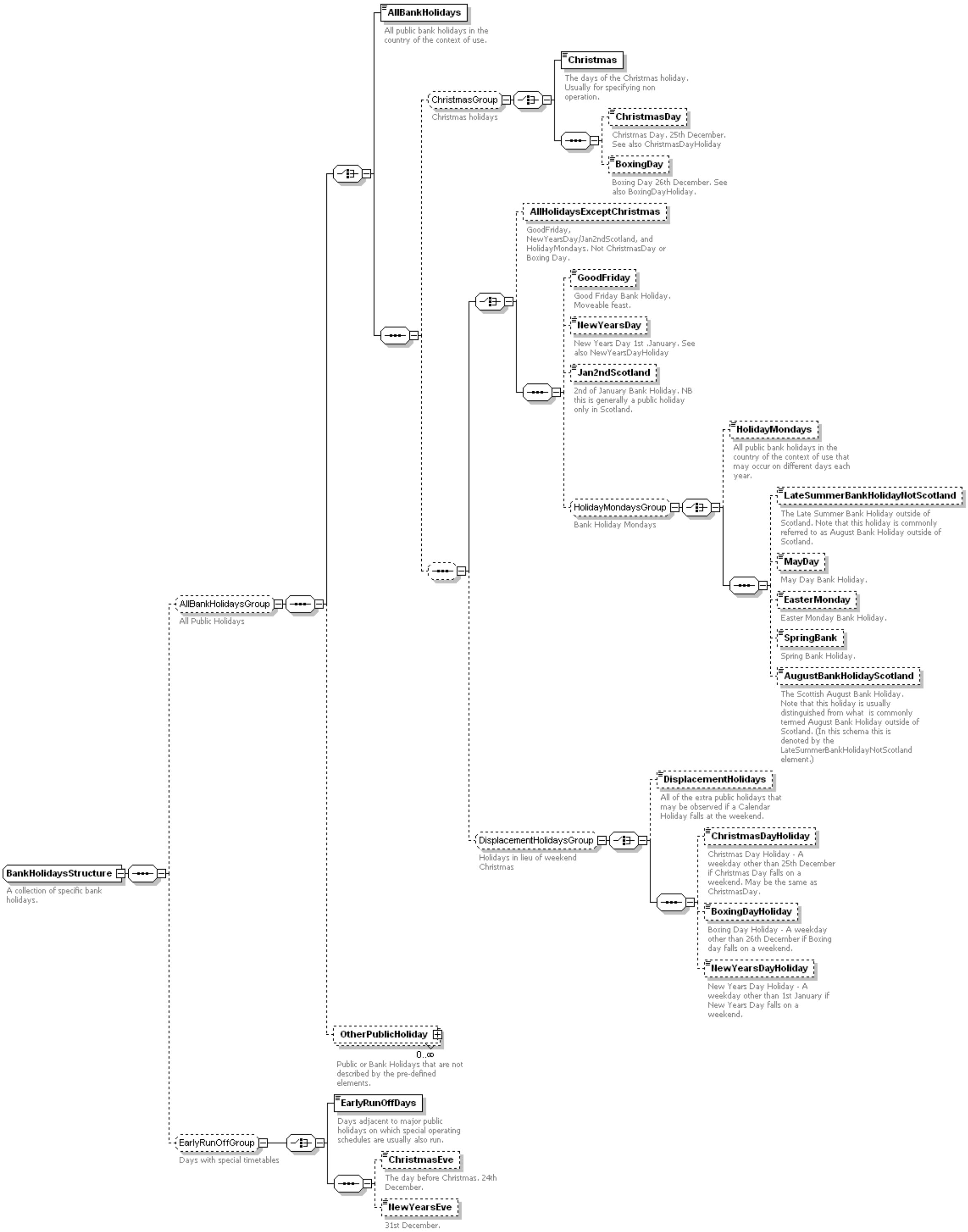

AllBankHolidays
All public bank holidays in the country of the context of use.
ChristmasGroup
Christmas holidays
Christmas
The days of the Christmas holiday. Usually for specifying non operation.
ChristmasDay
Christmas Day. 25th December. See also ChristmasDayHoliday
BoxingDay
Boxing Day 26th December. See also BoxingDayHoliday.
AllHolidaysExceptChristmas
GoodFriday, NewYearsDay/Jan2ndScotland, and HolidayMondays. Not ChristmasDay or Boxing Day.
GoodFriday
Good Friday Bank Holiday. Moveable feast.
NewYearsDay
New Years Day 1st .January. See also NewYearsDayHoliday
Jan2ndScotland
2nd of January Bank Holiday. NB this is generally a public holiday only in Scotland.
HolidayMondays
All public bank holidays in the country of the context of use that may occur on different days each year.
HolidayMondaysGroup
Bank Holiday Mondays
LateSummerBankHolidayNotScotland
The Late Summer Bank Holiday outside of Scotland. Note that this holiday is commonly referred to as August Bank Holiday outside of Scotland.
MayDay
May Day Bank Holiday.
EasterMonday
Easter Monday Bank Holiday.
SpringBank
Spring Bank Holiday.
AugustBankHolidayScotland
The Scottish August Bank Holiday. Note that this holiday is usually distinguished from what is commonly termed August Bank Holiday outside of Scotland. (In this schema this is denoted by the LateSummerBankHolidayNotScotland element.)
AllBankHolidaysGroup
All Public Holidays
DisplacementHolidays
All of the extra public holidays that may be observed if a Calendar Holiday falls at the weekend.
DisplacementHolidaysGroup
Holidays in lieu of weekend Christmas
ChristmasDayHoliday
Christmas Day Holiday - A weekday other than 25th December if Christmas Day falls on a weekend. May be the same as ChristmasDay.
BoxingDayHoliday
Boxing Day Holiday - A weekday other than 26th December if Boxing day falls on a weekend.
NewYearsDayHoliday
New Years Day Holiday - A weekday other than 1st January if New Years Day falls on a weekend.
BankHolidaysStructure
A collection of specific bank holidays.
OtherPublicHoliday
0..∞
Public or Bank Holidays that are not described by the pre-defined elements.
EarlyRunOffDays
Days adjacent to major public holidays on which special operating schedules are usually also run.
EarlyRunOffGroup
Days with special timetables
ChristmasEve
The day before Christmas. 24th December.
NewYearsEve
31st December.

Figure 6-98 – OperatingProfile / Bank Holidays Element

6.9.3 ServicedOrganisation Element

Operational days can also be specified in terms of the working days or holidays of specified organisations, for example schools. The ***ServicedOrganisation*** element is used to define the organisations covered, and to specify their working and non-working days.
A *TransXChange* document may contain a collection of ***ServicedOrganisation*** definitions. Each ***ServicedOrganisation*** definition (*Figure 6-99*) comprises:

- ***OrganisationCode***: Identifier of the ***ServicedOrganisation***.
- ***Name***: Name of the ***ServicedOrganisation***.
- ***WorkingDays***: The working days of the ***ServicedOrganisation***, for example a LEA's terms.
- ***Holidays***: The non-working days of the ***ServicedOrganisation***, for example a LEA's holidays.
- ***ParentRef***: Identifier of another ***ServicedOrganisation*** that is the element's parent. References should be acyclic. Working days and holidays specified for a parent are used as defaults for all child organisations, unless specifically overridden on the child instance.

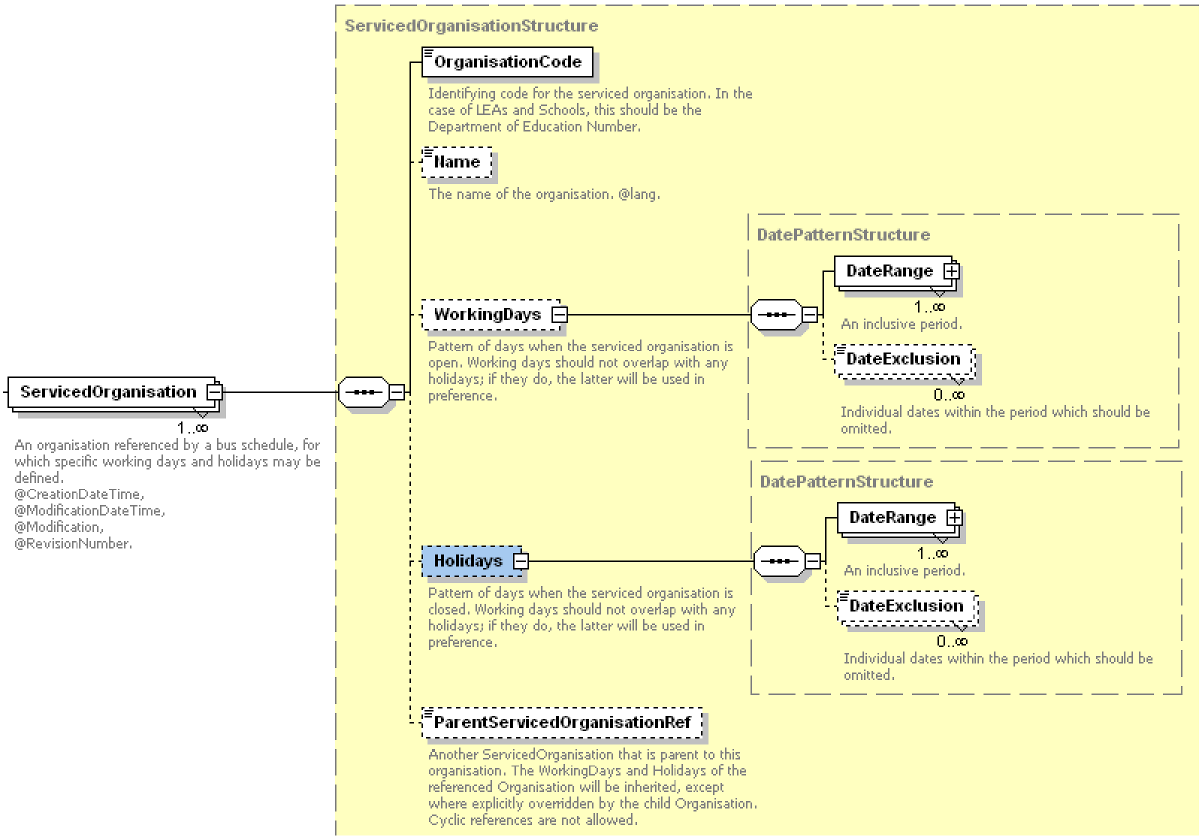

ServicedOrganisationStructure
OrganisationCode
Identifying code for the serviced organisation. In the case of LEAs and Schools, this should be the Department of Education Number.
Name
The name of the organisation. @lang.
WorkingDays
Pattern of days when the serviced organisation is open. Working days should not overlap with any holidays; if they do, the latter will be used in preference.
DatePatternStructure
DateRange
1..∞
An inclusive period.
DateExclusion
0..∞
Individual dates within the period which should be omitted.
ServicedOrganisation
1..∞
An organisation referenced by a bus schedule, for which specific working days and holidays may be defined.
@CreationDateTime,
@ModificationDateTime,
@Modification,
@RevisionNumber.
DatePatternStructure
DateRange
1..∞
An inclusive period.
Holidays
Pattern of days when the serviced organisation is closed. Working days should not overlap with any holidays; if they do, the latter will be used in preference.
DateExclusion
0..∞
Individual dates within the period which should be omitted.
ParentServicedOrganisationRef
Another ServicedOrganisation that is parent to this organisation. The WorkingDays and Holidays of the referenced Organisation will be inherited, except where explicitly overridden by the child Organisation. Cyclic references are not allowed.

Figure 6-99 – ServicedOrganisation Element

6.9.4 ServicedOrganisation Subelements

6.9.4.1 ServicedOrganisation / DatePattern Element

The ***DatePattern*** element (*Figure 6-100***)** specifies a group of one or more non-contiguous periods as a collection of date ranges. See Modelling operation days for precedence of overlapping dates.

- ***DateRange***: A collection of one or more open-ended date ranges, and any number of date exceptions.

  - ***StartDate***: The (inclusive) start date. If omitted, the range start is open-ended, that is, it should be interpreted as "since the beginning of time".
  - ***EndDate***: The (inclusive) end date. If omitted, the range end is open-ended, that is, it should be interpreted as "forever"
- ***DateExclusion***: Individual dates within the period which should be omitted.

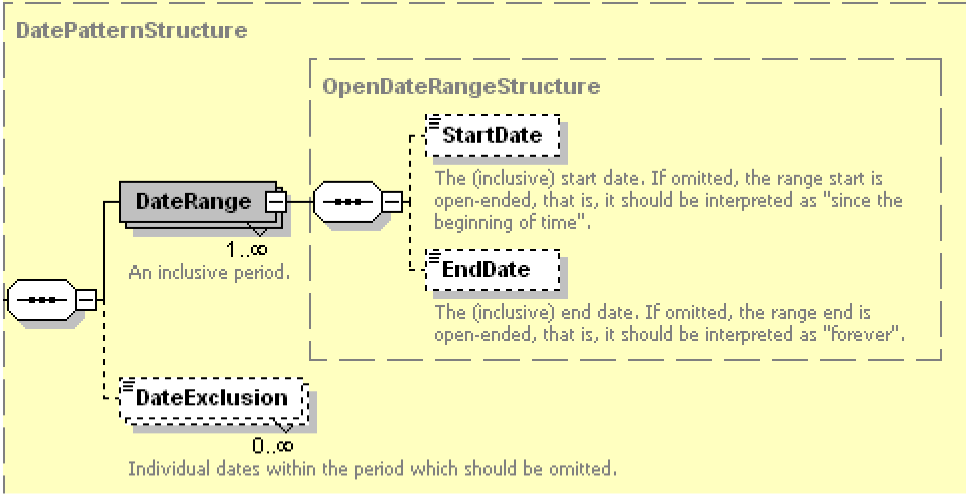

DatePatternStructure
OpenDateRangeStructure
StartDate
The (inclusive) start date. If omitted, the range start is open-ended, that is, it should be interpreted as "since the beginning of time".
DateRange
1..∞
An inclusive period.
EndDate
The (inclusive) end date. If omitted, the range end is open-ended, that is, it should be interpreted as "forever".
DateExclusion
0..∞
Individual dates within the period which should be omitted.

Figure 6-100 – ServicedOrganisation / Date Pattern

6.10 Miscellaneous Elements

6.10.1 SupportingDocument Element

The ***SupportingDocument*** element (*Figure 6-26*) Associates any supporting documents associated with the whole *TransXChange* schedule document – other documents, for example a schematic map, may be associated with individual elements using specific tags. Documents may be in any file format and are identified by a ***DocumentUri***. Note that documents can also be associated more specifically with an individual registration.

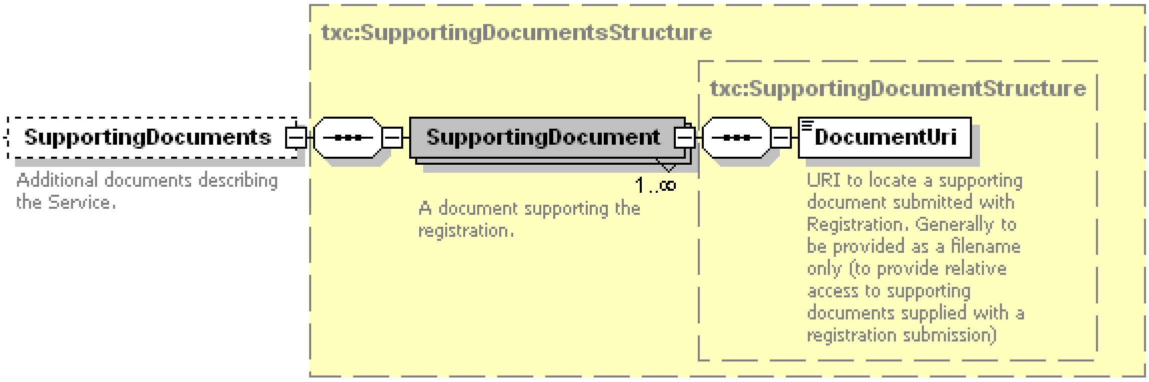

txc:SupportingDocumentsStructure
txc:SupportingDocumentStructure
SupportingDocuments
Additional documents describing the Service.
SupportingDocument
1..∞
A document supporting the registration.
DocumentUri
URI to locate a supporting document submitted with Registration. Generally to be provided as a filename only (to provide relative access to supporting documents supplied with a registration submission)

Figure 6-101 – SupportingDocument Element

7 COMMON SCHEMA ELEMENTS

Some elements and types are common to a number of different elements in the *TransXChange & NaPTAN* schemas. These are described here.

7.1 LocationStructure

The ***LocationStructure*** type (*Figure 7-1*) is used to describe the spatial position of a stop or other point, for example on a ***Location*** element. Coordinates may be specified in Grid or WGS84 formats, or both. The primary coordinates used can be indicated by the ***LocationSystem*** value (*Grid* or *WGS84*) specified on ***TransXChange*** document root elements. Coordinates must be supplied for all elements in the specified primary coordinates, and may optionally be provided in the other system as well. *NaPTAN* data should be submitted in *Grid* format. *NaPTAN* data will normally be distributed in both formats.

If *Grid* coordinates are provided:

- ***GridType:*** Nominated grid system e.g. UKOS or IrishOS; UKOS is assumed by default.
- ***Easting***: Easting grid coordinates of stop.
- ***Northing***: Northing grid coordinates of stop.

If *WGS84* coordinates are provided:

- ***Longitude***: Longitude of stop in *WGS84* coordinates.
- ***Latitude***: Latitude of stop in *WGS84* coordinates.

If Both Grid & *WGS84* coordinates are provided:

- ***Translation***, containing both of the above coordinate groups.

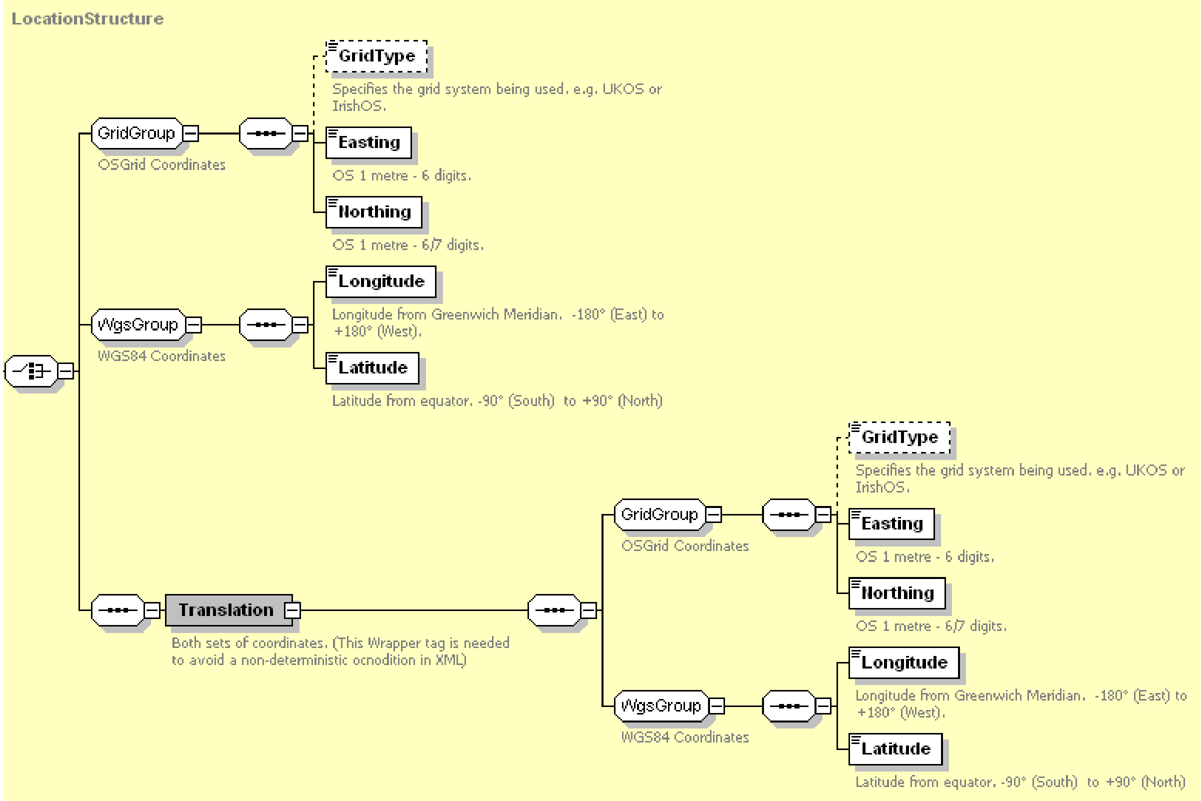

LocationStructure
GridGroup
OSGrid Coordinates
GridType
Specifies the grid system being used. e.g. UKOS or IrishOS.
Easting
OS 1 metre - 6 digits.
Northing
OS 1 metre - 6/7 digits.
WgsGroup
WGS84 Coordinates
Longitude
Longitude from Greenwich Meridian. -180° (East) to +180° (West).
Latitude
Latitude from equator. -90° (South) to +90° (North)
Translation
Both sets of coordinates. (This Wrapper tag is needed to avoid a non-deterministic ocnodition in XML)
GridGroup
OSGrid Coordinates
GridType
Specifies the grid system being used. e.g. UKOS or IrishOS.
Easting
OS 1 metre - 6 digits.
Northing
OS 1 metre - 6/7 digits.
WgsGroup
WGS84 Coordinates
Longitude
Longitude from Greenwich Meridian. -180° (East) to +180° (West).
Latitude
Latitude from equator. -90° (South) to +90° (North)

Figure 7-1 – LocationStructure

7.2 Duration Simple Type

The ***Duration*** simple type is used by a number of elements to specify a relative time in minutes and seconds. It uses a standard W3C ***duration*** type.
See http://www.w3.org/TR/2001/REC-xmlschema-2-20010502/#duration.
Durations are encoded in the format *PT99M88S*, where *99* is the minutes and *88* is the seconds. For example, '*PT12M22S'* denotes twelve minutes and twenty-two seconds. The seconds may be omitted for whole minutes, for example, *PT5M*. Note that the W3C format also allows years, month, week and day intervals as well but these are not needed for timing intervals. The W3C definition allows arbitrary integer values for the minutes and arbitrary decimal values for the number of seconds can include decimal digits to arbitrary precision. thus PT1201M, PT360.25S or PT1000S are valid (i.e. seconds do not have to be modulo sixty). Either seconds or minutes or both may be coded. Units may be combined in an arbitrary manner for example, P5M, PT300S and PT3M120S are all valid equivalent encodings of 5 minutes.

7.3 TelephoneContactStructure Element

The ***TelephoneContactStructure*** (*Figure 7-2*) element specifies a phone number:

- ***TelNationalNumber***: Full telephone number including STD prefix
- ***TelExtensionNumber***: Any extension number.
- ***TelCountryCode***: International country code for telephone. E.g. +44.

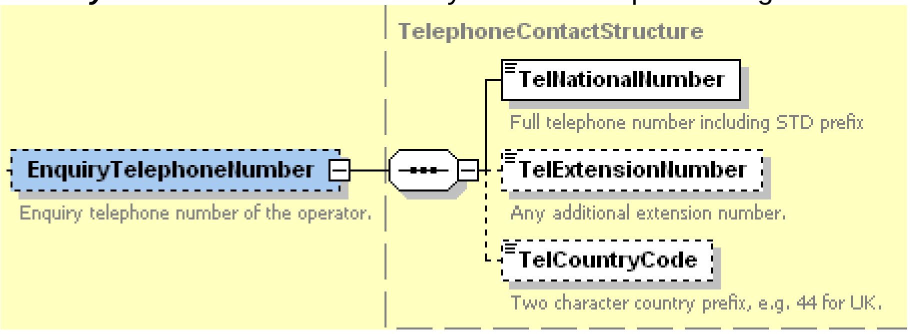

TelephoneContactStructure
TelNationalNumber
Full telephone number including STD prefix
EnquiryTelephoneNumber
Enquiry telephone number of the operator.
TelExtensionNumber
Any additional extension number.
TelCountryCode
Two character country prefix, e.g. 44 for UK.

Figure 7-2 – TelephoneContactStructure

7.4 PostalAddressStructure Element

The ***PostalAddressStructure*** (*Figure 7-3*) element specifies a postal address.

- ***Line***: Between two and five lines of address.
- ***PostCode***: Post code of address.

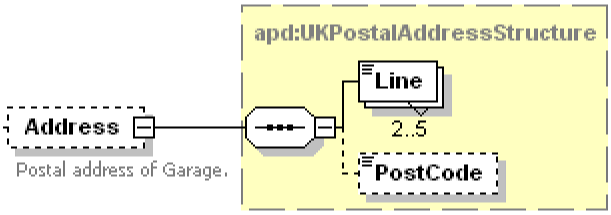


Figure 7-3 – PostalAddressStructure Element

7.5 Note Element

A ***Note*** (*Figure 7-4*) models a set of notes attached to an element:

- ***NoteCode:*** Note identifier.
- ***NoteText:*** Text of note.

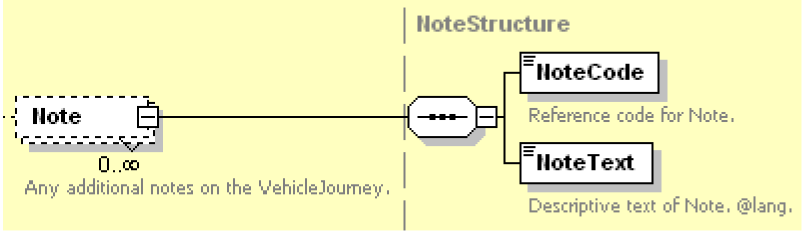

NoteStructure
Note
0..∞
Any additional notes on the VehicleJourney.
NoteCode
Reference code for Note.
NoteText
Descriptive text of Note. @lang.

Figure 7-4 – Note Element

8 ELECTRONIC BUS SERVICE REGISTRATION PROCESS

This section summarises the anticipated process for registering a Bus Service using *TransXChange*. The proposed process is subject to confirmation by VOSA following formal testing in a demonstration. Registration includes the following steps:

8.1 Step 1: Preparation

The Transport Operator creates a proposal for a bus service and follows his normal arrangements for consulting local authorities and others as appropriate before registering the proposal.

8.2 Step 2: Encoding

The Transport Operator or its agent transfers the proposal onto a computer system. This could be either a system that handles the scheduling of operations (and which includes the capability to output the registration as *TransXChange* registration compliant XML document), or a simpler system that only creates TransXChange registration files. Some operators may use an agency to do this work for them – and in some areas the local authority might offer to act as an agent, particularly in respect of contract services. Each service Registration will create a separate *TransXChange* file – and these will be referenced using the operator's next available registration number. Each change to a Registration likewise will carry a new sequential "version number".

8.3 Step 3: Transmission

The Operator or the Operator's agent logs onto the internet and connects to the VOSA Server with a normal web browser (MS Internet Explorer, Netscape, etc) using a previously-allocated username and password. The VOSA system provides a secure web connection over which the electronic registration details can be sent to the relevant Traffic Area Office. The VOSA service will offer a web page through which *TransXChange* files can be submitted, individually or in bulk. Files can be zipped (compressed) to reduce connection times – and multiple files can be submitted in a single zipped file. Files will be stored in a secure area of the VOSA web site and will be accessible only to the relevant Traffic Area staff, the operator making the submission and to the local authorities in whose area the service is to operate.

8.4 Step 4: Validation

The VOSA system will check that each file (unzipped, if necessary) meets the technical requirements of *TransXChange* – and will send a message back to the operator immediately if the file(s) fail this test. If each file passes the test, then the VOSA system will send an e-mail the relevant local authority (or authorities) and to the operator to advise them that a registration(s) has been submitted and they can collect the submitted file(s) through their own internet connection to a secure area of the VOSA web site

8.5 Step 5: TAN Review

Copies of the submitted file(s) are now passed into the Traffic Area Office's business system for review in the appropriate Traffic Area Office. Some automatic checks are made on the content of the file – and the report of these checks is then passed to a case worker who will review the proposal and, once any problems are resolved, issue the acceptance for each Registration. The acceptance creates a new file – in PDF format – which provides an unchangeable record of the "registered particulars" contained in the *TransXChange* file. This file will be put into the secure area of the VOSA web site. Both the operator of the service, and the local authorities in whose area the service is to operate, will be advised by e-mail that the Registration has been accepted and that the PDF file of its registered particulars is available for downloading securely from the web site. If problems are found with the registration proposals during this process, the operator may be invited to make changes to their proposals and to resubmit them, starting again at Step 2 of this process.

8.6 Step 6: Acceptance and Distribution

The operator who submitted the registration (and the relevant local authorities) can then download a copy of the PDF file and can view the content of this file using freely available software (such as Adobe Acrobat Reader). This provides confirmation of the acceptance of the Registration – and sets out the only information (particularly the timetable shown only at principal "timing" points) to which the Traffic Commissioner can make reference in any enforcement proceedings.

The files submitted or created during this process will remain accessible through the VOSA web site for up to 90 days using the secure access codes provided in the e-mails sent to the operator and to the relevant local authorities. After that period, the files can still be obtained on request from the relevant Traffic Area Office.

The electronic Registration process will be the same, whether the proposal is to register a new service, to change an existing registered service, or to cancel an existing service. Changes to an existing Registration require the re-submission of the complete registration details using *TransXChange* (but most of these details will have been stored in the operator's systems for re-use in such circumstances). Cancellations require the submission of a very small TransXChange file that identifies the Registration concerned and the last date of operation.

TransXChange files can include timetables for use not only on normal operating days, but also those which will be used on Bank Holidays and on other special days (such as those around Christmas and the New Year). Operators will be encouraged to make full use of these facilities so that special timetables are available for public information systems well in advance of each special day of operation, and to avoid the need to submit special registrations (or notifications) for such services.

9 THE TRANSXCHANGE PUBLISHER

The *TransXChange* Publisher is a free tool issued along with *TransXChange,* which allows users to render *TransXChange* XML documents into a readable timetable-like layout, that uses the *Acrobat* pdf file format. See Figure 9-1. The free **Acrobat** reader from Adobe Inc (http://www.adobe.com) can be used to read and print .pdf files.

The Publisher can be invoked from a Desktop GUI, or a command line. It has options to produce

- **Particulars**. The particulars section includes a summary of the contents of the TransXChange document, (for example how many stops and journeys) followed by a textual listing of the entities described in the file (such as operators, services, routes, and stops).
- **Timetable**. The timetable section contains matrix timetables for the services in the *TransXChange* document. Separate timetables are generated for different services, directions (e.g. outbound and inbound), and day types (e.g. a Monday to Friday timetable, and a Saturday timetable).
- **Diagnostic Report.** The diagnostics section contains a report detailing violations of consistency checks for the TransXChange document (over and above those expressed in the TransXChange XML Schemas alone).
- **Route Track**. The route track section is a separate pdf document. It consists of route plots for the services in the TransXChange on a map background along with an accompanying table of stops. It requires an on-lien connection to use.

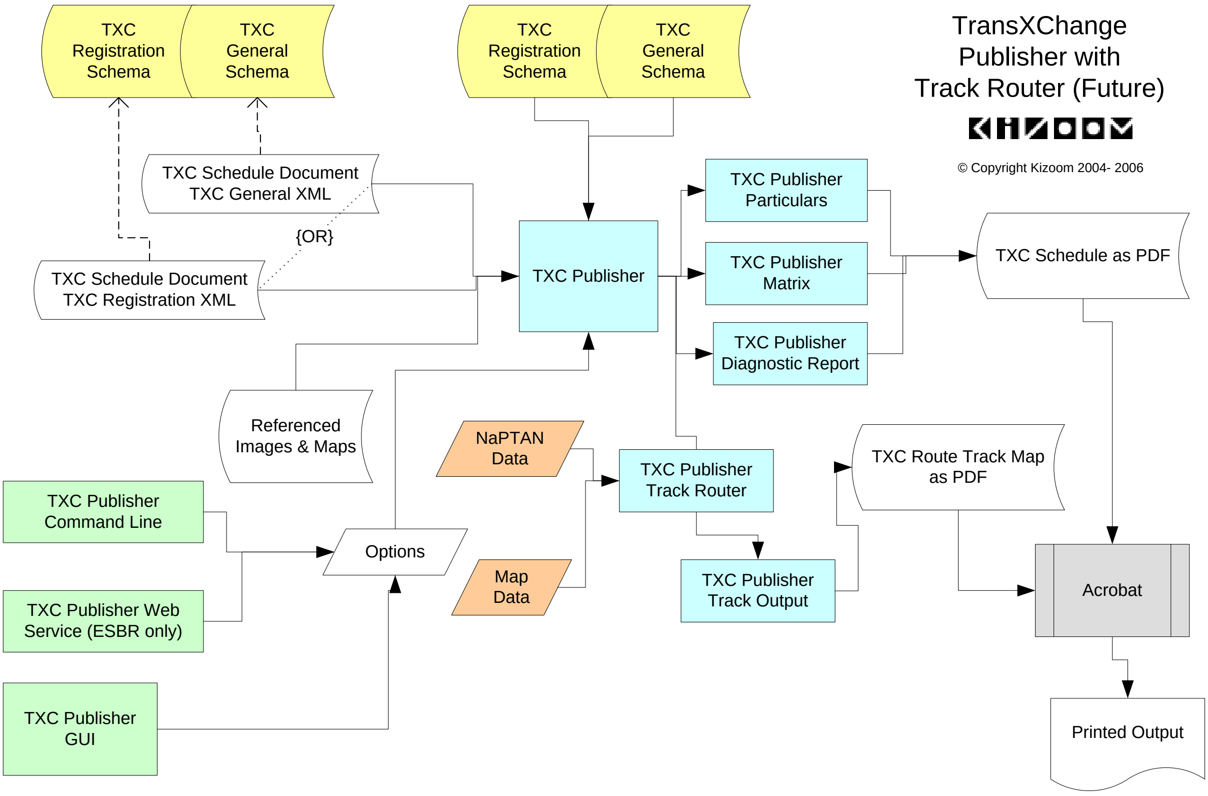

TXC Registration Schema
TXC General Schema
TXC Registration Schema
TXC General Schema
TransXChange Publisher with Track Router (Future)
© Copyright Kizoom 2004- 2006
TXC Schedule Document TXC General XML
{OR}
TXC Schedule Document TXC Registration XML
TXC Publisher
TXC Publisher Particulars
TXC Publisher Matrix
TXC Publisher Diagnostic Report
TXC Schedule as PDF
Referenced Images & Maps
NaPTAN Data
TXC Publisher Track Router
TXC Route Track Map as PDF
TXC Publisher Command Line
Options
Map Data
TXC Publisher Track Output
Acrobat
TXC Publisher Web Service (ESBR only)
TXC Publisher GUI
Printed Output

Figure 9-1 – Publisher

9.1 Required Environment

The *TransXChange Publisher* requires the installation of a standard open source environment for running Java (Java Runtime Environment 1.4.2 or higher). See Installation instructions for platform requirements.

The Route Track option requires a broadband internet connection to access the web services that provide stop and map data.

9.2 Installation Process

The Publisher is available as a downloadable zip at http://www.transxchange.org.uk.

Installation instructions and examples are included on the site.

9.3 Run Time Options

The Publisher has a number of run time options
(a) To control the content to be included.
(b) To specify various aspects of the rendering of content.

9.4 Generalised list of Publisher parameters

Group	*Parameter*	*Data type*	*Default*	*Description*	*WS*	*Comm and Line*	*GUI*
Input Operands	**Document-Path**	*url*	Required	*Name and Path to TransXChange XML document and associated files that are to be published.*	*Y*	*Y*	*Y*
Output Operands	**OutputPath**	*url*	Optional	*Output directory in which to place published output. If not otherwise specified, output is placed in the same directory as the input document*	*Y*	*Y*	*Y*
Processing options	**ValidateXML**	*boolean*	true	*Apply XML validation -*	*Y*	*Y+*	*Y*
Output Section Content Options	**Auto**	*Vosa |vosaAll |full*		*Options controlling the interpretation of auto* *See Parameter defaults below -*	*Y*	*Y*	*Y*
	Particulars	*none | basic | full*	full	*Include the particulars in output.* • *auto – default by pub format* • *none – no partiucalrs* • *basic –basic particulars*	*Y*	*Y [1]*	*Y*
	Timetable	*none | basic | full*	full	*Include the timetable matrix in output.* • *auto – default by pub format* • *none – no matrix* • *basic – Omit footnotes* • *full - Include the timetable footnotes in output.*	*Y*	*Y [1]*	*Y*

	RouteTrack	*none | plain | basic | tiled*	none	*Include the route track in output. Default is false.* • *auto – default by pub format* • *none – no routetrack* • *plain – no map tiles* • *basic – Omit stop list*	*Y*	*Y+*	*Y*
	Embed	*boolean*	true	*Include any embedded image content in output.*	*Y*	*N*	*Y*
	Diagnostics	*auto | none | full*	auto	*Publish a diagnostic section.*	*Y*	*Y [2]*	*Y*
Filters	**TimingPoints**	*All |PTP |*	All [3]	*Include timing points of this type.*	*Y*	*Y [3]*	*Y*
	MergeFrequencyMergeFrequency-Journeys	*boolean*	true	*Merge similar frequent journeys into a single column.*	*Y*	*N*	*Y*
Route Track Map	**RouteScale**	*Auto | Small | Large*	Auto	Scale to use when tiling map. Small: 1:10,000, Large 1:50:000. Auto: scale to size	*Y*	*N+*	*Y*
	Route-Grouping	*Single | ByDirection*	false	*One route per map, or per direction.*	*Y*	*Y+*	*Y*
	RouteTiling	*A4 | none*	A4	*Output as A4 tiles or single image.*	*Y*	*N+*	*Y*
	StopData	*localOnly | web service*	Web-Service	*Source of stop coordinates.*	*Y*	*N*	*Y*
	MapData	*none | web service*	Web-Service	*Source of map tiles. Only used if RouteTrackMap specified.*	*Y*	*N*	*Y*
Watermark	**Background**	*Official | Vosa | Other*	Vosa	*Controls image.*	*Y*	*[N]*	*N*
Watermark	**Rubric**	*Official | Vosa | Other*	Vosa	*Controls headings and watermark.*	*Y*	*[N]*	*N*
Rendering	**Output-Format**	*Pdf | html*	pdf	*Output format pdf*	*Y*	*(Y) [4]s*	*Y*

Table 8-9 – Publisher Interface Parameters

[1] Command line by suppressing other parts: timetableOnly.
[2] Controlled in command line by suppression: novalidation.
full
[4] Matrix only/ HTML output is a Debug Tool -

9.5 Publishing Actions

The Publisher publishes a document in the following order:

- Summary Page
- Operator
- Serviced Organisations
- Services
- Registrations
    i. ShortNoticeRegistrations
- Lines
- Routes
    i. Local Stop Declarations
    ii. References to existing stops

        iii. Embedded Map
- Fixed Route Services
    1. Outbound VehicleJourneys
        1. Monday to Friday
            1. Matrix
            2. Notes
        2. Saturday
            1. Matrix
            2. Notes
        3. Sunday
            1. Matrix
            2. Notes
    2. Inbound VehicleJourneys
        1. Monday to Friday
            1. Matrix
            2. Notes
        2. Saturday
            1. Matrix
            2. Notes
        3. Sunday
            1. Matrix
        4. Notes
- Flexible Route Services
    1. Flexible Stops
    2. Fixed Stops
    3. Timebands
- Supporting documents

10 NAMING & CODING CONVENTIONS

Systematic naming conventions and a consistent coding style are used in the *TransXChange* 2.0 schemas. These conventions are summarised in this section.

10.1 Naming of Elements

TransXChange follows consistent principle for naming elements:

10.1.1 Use of Camel Case

Camel case is used for all names in the XML schema:

- Upper camel case is used for element and attribute names, for example ***JourneyPatternTimingLink***, ***HailAndRide***.
- Lower case is however used for two standard attributes: ***xsd:lang*** and ***id***, following W3C usage.
- Lower camel case is preferred or enumerated character values, for example '*saturdayMorning',* except for proper names, which may be capitalised, e.g. '*IsleOfMan*
- Acronyms are treated as words for capitalisation, thus ***TanCode***, not ***TANCode***. This is one point where we follow common best practice but diverge from e-gif. Treating acronyms as words allows for a uniform parsing of names to derive their components, and avoids ambiguity on case of contiguous acronyms, for example ***TANAPD*** vs. ***TanApd***, or one letter words contiguous with an acronym, for example ***DialATAN*** vs. ***DialATan.***

10.1.2 Use of Standard Name Suffixes

TransXChange and *NaPT schema e*lement, type and attribute names have been revised along consistent principles:

- All simple types end with the suffix '***Type'***.
- All complex types end with '***Structure'***.
- All enumerations end with '***Enumeration'***.
- All groups end with '***Group'***.
- Elements representing references to other entities are suffixed with '***Ref'***.
- Externally referenced identifiers of entities are generally suffixed with '***Code'*** (and represented as elements). Code values are usually unique for the element type within a document.
- Internally referenced identifiers are generally named with '***id'*** (and represented as attributes). id attributes typically have a keyref constraint on their uniqueness. The uniqueness scope for id attributes is normally for the element type within an instance document, but could also be just within an instance of specified element.
- Externally referenced classifiers of entities are generally suffixed with '***Classification'*** (rather than say '***Type'***). (Some exceptions are made to this rule for legacy usage).
- Externally referenced names of entities are generally suffixed with '***Name'***. If the context is readily apparent they may be called just Name.
- Natural Language text descriptions of entities are generally termed '***Description'***.

10.1.3 Meaningful Names

Several other consistent naming principles are followed:

- Abbreviations are generally avoided – for example '***Operations'*** is preferred to 'Op'.
- A container element representing a one-to-many relationship is in the plural; for example, ***StopPoints*** contains one or more ***StopPoint*** elements.

- We avoid repeating the name of the parent element as an adjective in individual child elements, except where for semantically important elements. Thus for example, ***Author*** contains ***Title***, ***Position***, ***Forename***, ***Surname***, not ***AuthorTitle***, ***AuthorPosition***, ***AuthorName***, ***AuthorSurname***
- We avoid the use in domain elements names of terms that have strong software connotations:
    - The suffixes '***Type'*** and '***Group'*** are avoided in element names except for internal schema elements.
    - The term '***Exclusion'*** is used generically to denote an exclusion period for the service (rather than the previous term Exception) e.g. ***JourneyPatternExclusion***.

10.1.4 Semantically Significant Order

Several principles are used to order the subelements at any given level of containment:

- When declaring elements within a parent, subelements are placed in a consistent general order according to the nature of their role as follows:
    - (i) Elements that identify the entity, such as codes or numbers.
    - (ii) Elements that classify the entity.
    - (iii) Elements that describe the element in text, such as names or descriptions.
    - (iv) Elements describing other properties of the entity.
- Where there is an inherent temporal order, elements are placed in temporal sequence.

10.1.5 Standardised Terminology

An attempt has been made to use the appropriate *Transmodel* term wherever appropriate. For example ***Garage*** rather than ***Depot***. The main divergences from *Transmodel* are listed in section 13.2.

10.2 Typing of Elements

Some general principles are used for typing values.

- Explicit, specific types are used wherever possible, for example ***Duration***:
- Complex types are declared for all significant elements.
- Internally referenced identifiers are generally of type NMTOKEN.
- Elements whose content is a text string in a national language are of type ***NaturalLanguageStringStructure.***

10.3 Element Constraints

Some general principles are used for constraining values.

- *Mandatory Elements are normally populated.* XML constraints are usually specified to ensure mandatory elements are populated, for example strings should contain at least one character.

- *Optional elements not empty:* Where alternative structures are available, the absence of an element is not relied upon to infer meaning. Instead an empty element or attribute value is used to make the condition explicit, or there is a default value defined. This principle has been generally been followed for new and remodelled features.

10.4 Use of Attributes

In *TransXChange,* XML element attributes are generally used only for metadata, that is, data about data, such as change dates, or internal identifiers. *Table 10-1* summarises the attributes used in *TransXChange.*

Group	Element	Attribute	
Version	***TransXChange*** root element.	***CreationDateTime***	*1.2*
		ModificationDateTime	*1.2*
		FileName	*2.0*
		SchemaVersion	*1.2*
	StopPoint, StopArea, Service , VehicleJourney, Route, RouteLink, FlexibleZone, Registration, JourneyPattern, Operator	***Modification,***	*1.2*
		RevisionNumber	*1.2*
id	***Route***	***id***	*1.2*
	JourneyPattern	***id***	*1.2*
	DeadRun	***id***	*2.0*
	RouteSection	***id***	*2.0*
	JourneyPatternSection	***id***	*2.0*
	RouteLink	***id***	*1.2*
	JourneyPatternTimingLink	***id***	*1.2*
	VehicleJourneyTimingLink	***id***	*1.2*
	PositioningLink	***id***	*2.0*
	JourneyPatternStopUsage	***id***	*1.2*
	VehicleJourneyTimingLink	***id***	*1.2*
	JourneyPatternInterchange	***id***	*1.2*
	VehicleJourneyInterchange	***id***	*1.2*
	Location	***id***	*1.2*
Data	***Location***	***Precision***	*1.2*
	JourneyPatternStopUsage	***SequenceNumber***	*2.0*
	Route / Track / MapSystemReference	***MappingSystem***	*2.0*
Language	Text éléments***: Name, Description,*** etc. See section on National Language Support	***xml:lang***	*2.0*

Table 10-1 – TransXChange Attributes

10.5 Implementation of Model Relationships

In *TransXChange,* some stylistic conventions are used to make clear the mapping of the reference model relationships into the XML schema.

- Significant entities have a uniquely scoped identifier (always an element named ***xxxCode,*** or ***xxxNumber***, or an id attribute).
- Relationships are implemented by placing a reference to the identifier as a foreign key on the referencing element (shown by the navigability arrow in UML diagrams). The reference has the form ***xxxRef***. For example, ***StopPoint*** is identified by an ***AtcoCode,*** and referenced in relationships by a ***StopPointRef***.
- Container elements are generally used for significant one-to-many relationships, for example ***StopPoints*** contains the ***StopPoint*** elements.

11 NATIONAL LANGUAGE SUPPORT

TransXChange is enabled to allow the coding of schemas in different National Languages, such as Welsh.

11.1 Text Content Types

The textual data of a *TransXChange* schedule falls into three different categories:

- **Fixed Text**: National Language Translations of fixed encoded *TransXChange* values (for example the TAN area names), and terminology for concepts such as 'Service' rendered when using a style sheet to transform a schedule into a published format.
- **Free Text:** The contents of data elements that can be specified as content for textual elements (having an xml:***lang*** attribute and a type of ***NaturalLanguageStringType***), for example operator names, route descriptions and other notes.
- **External Data:** The contents of data fetched from external data systems, for example *NaPTAN* stop names.

11.1.1 Use of Fixed Text

An overall **xml:lang** attribute is specified at the schema level on the ***TransXChange*** root element. This specifies the default language for the schedule, i.e. the default implied language that is to be used to publish the timetable. It defaults to English.

- Translations can be established for the text associated with the different fixed elements.

11.1.2 Use of Free Text

Elements which may contain free text in a natural language (*Table 11-1*), such as Welsh or English, have an **xml:lang** language attribute to indicate the language in which they are in.

- English is assumed if no attribute is specified.
- The provision of alternative names for a stop in different languages is covered by *NaPTAN*, which allows for multiple alternative names.

Group	Element	Note
StopPoint	***CommonName***	Use NaPTAN
	NptgLocalityName	
	StopArea / Name	
Organisation	***ServicedOrganisation / Name***	
FlexibleZone	***FlexibleZone / Description***	
Route	***Route / Description***	
	Route / Manoeuvre	
	Instruction / Summary	
	Track / Feature / OnwardName	
	Track / Feature / Description	
Service	***Origin***	
	Destination	
	ServiceClassification / OtherService / Description	
	StopRequirements / NewStopsRequired / Note	
	Description	
	Note / NoteText	
	ToBeMarketedWith / RelatedService / Description	
	ContractedService / Description	
	QualityPartnership	
JourneyPattern	***DestinationDisplay***	
	Block	
	LayoverPoint / Name	
	VehicleType / Description	
	Frequency / Description	
	JourneyPatternTimingLink / StoppingArrangements	

	JourneyPatternTimingLink / StopUsage / Note	
VehicleJourney	***Note***	
Interchange	***Interchange / StoppingArrangements***	
OperatingProfile	***OtherPublicHoliday / Description***	
Operator	***OperatorNameOnLicence***	
	Garage / GarageName	
Registration	***Author / Position***	
	SubsidyDetails / SubsidisingAuthority	
	StopRequired	
	NoteText	
Short Notice Registration	***PublicAvailability / NonAvailabilityDescription***	
	ChangeImpact / MinorChangeDescription	
	ReplaceDiscontinuedService / DiscontinuedService/ Description	
	LocalHolidayChange / LocalHolidayNote	
	SpecialOccasion / SpecialOccasionName	
	RegulationOrderCompliance / TrafficOrderNote	
	OtherServiceType / Description	
	ChangeRequestedByExternalAuthority / ChangeRequestDescription	
	MiscellaneousJustification	

Table 11-1 – Elements That May Contain Natural Language Text

11.1.3 External Data

Any national language alternatives of **StopPoint** and **StopArea** names are provided by *NaPTAN*. The schema xsd:lang attribute should be used to determine the preferred language alternative to use when rendering names in timetables.

11.2 Publishing or Exchanging Documents

Note that the free text elements may only be in one language at a time in a given document. In order for the language specific free text elements of a schedule to be exchanged in multiple languages, the schedule must be republished in each language in turn.

12 VERSIONING

TransXChange schemas and documents must be versioned with an explicit version number so as to manage change in a distributed operating environment, and in particular to allow the inter-operability of versions of *TransXChange* running concurrently on different systems.

12.1 Version Numbering Convention

TransXChange follows the e-Gif convention for version numbering.

- *Released* Version numbers have the form *n.m*, (e.g. '3.0').
- *Drafts* have the form *n.mx* (e.g. '3.1a').
- The main version number (*n*) will be incremented when the change from the previous version of the schema will cause existing documents to fail to validate. For example if a new mandatory element is added.
- The minor version number (*m*) will be incremented when the change to the schema will allow existing documents to continue to validate. However some new documents may fail to validate against the old version (for example, if a new optional element is added).
- The draft version number (*x*) indicates that the version is still under discussion and may be subject to further changes. Generally it will be incremented to indicate a material change to a previous release or previous draft. Intermediate drafts will usually be withdrawn once they are superceded.

12.2 Resource Versions

12.2.1 Schema URI Version

In line with W3C practice, a separate directory and URL will be used for each version of the schemas; the schema name will remain the same (N.B. a directory rather than document level numbering system is preferred for the leaf schemas because it facilitates the management of multiple components of a modularised schema, and multiple document artefacts).
For example

- http://www.transxchange.org.uk/schemas/2.0f/TransXChange_registration.xsd

and

- http://www.transxchange.org.uk/schemas/3.1/TransXChange_general.xsd

Different versions will coexist at the same time. Old versions will generally first be deprecated, and then retired.

12.2.2 Namespace URI Version

e-GIF mandates that Namespace URI should not be versioned. (A different URL for the namespace and the schema) The following URI will be used for namespace.

- http://www.transxchange.org.uk/schemas/

12.2.3 Package Versions

TransXChange embeds a number of common type definition packages that are shared with other UK standards. For convenience, a separate copy of the common packages is distributed with each standard. The individual package files are given version numbers in line with the e-GIF system in order to ensure the correct version is used.

For example, for the shared NaPT stop definition types file might be called *NaPT_stop-v1-0.xsd.* It will be distributed in *TransXChange* as:

- http://www.transxchange.org.uk/schemas/2.0/napt/NaPT_stop-v1-0.xsd

12.3 Packages

The *TransXChange* schema is modularised into a number of packages, with a strict linear dependency. See *Figure 12-1.*

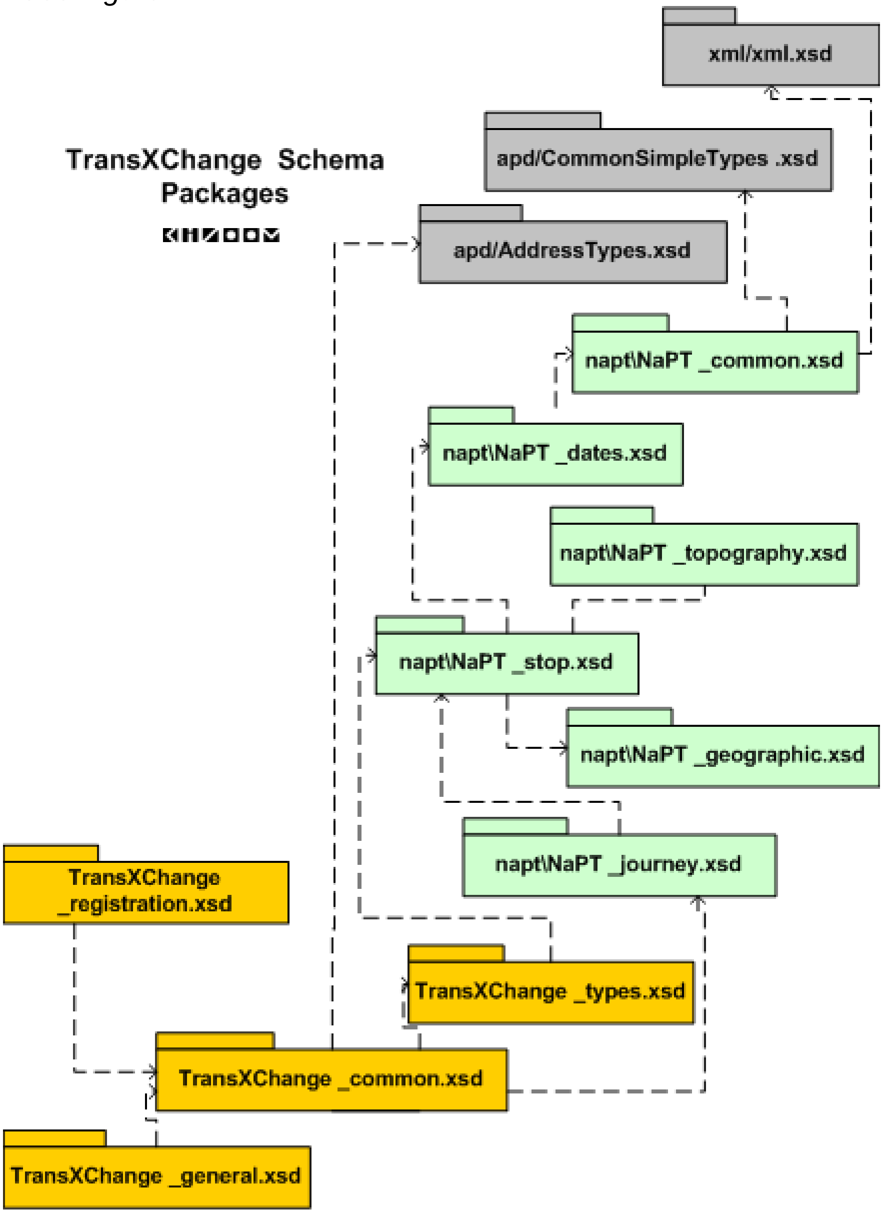


Figure 12-1 – TransXChange Packages

The schemas are organised according to package group (*see Table 12-1*). *TransXChange* schemas are placed in the root folder, prerequisite shared schemas are placed in subfolders (\apd, \napt and \xml).

Standard	Folder	Schemas	Contents	Origin
TransXChange	root	**TransXChange_registration.xsd**	Terminal schema for Registrations.	Renamed in 2.0.
	root	**TransXChange_general.xsd**	Terminal schema for General use.	Renamed in 2.0.
	root	**TransXChange_common.xsd**	Common elements for *TransXChange.*	New in 2.0.
	root	**TransXChange_types.xsd**	Shared type declarations specific to *TransXChange.*	New in 2.0.
NaPT	**\napt**	**NaPT_common.xsd**	Type declarations shared with other NaPT schema.	New in 2.0.
	\napt	**NaPT_dates.xsd**	Date and time type declarations shared with other NaPT schema.	New in 2.0.
	\napt	**NaPT_geographic.xsd**	Geographic type declarations shared with other NaPT schema.	New in 2.0.
	\napt	**NaPT_journey.xsd**	Journey type declarations shared with JourneyWeb schema.	New in 2.0.
	\napt	**NaPT_topography.xsd**	NPTG type declarations shared with other NaPT schema.	New in 2.0.
	\napt	**NaPT_stops.xsd**	Stop type declarations shared with other NaPT schema.	New in 2.0.
GovTalk	**\apd**	**AddessTypes.xsd**	UK address types	Referenced in 2.0
	\apd	**CommonSimpleTypes.xsd**	UK simple types	Referenced in 2.0
W3C	\xml	**XML.xsd**	Standard definitions of types	Referenced in 2.0

Table 12-1 – TransXChange 2.0 Module Names

12.4 Version Identifiers & Change Tracking

12.4.1 Schema Version Identifier

The *TransXChange* schema has an explicit version attribute on it, as recommended by e-GIF.

- The schema ***id*** is "*TransXChange*".
- The ***version*** identifier follows the versioning scheme e.g. "3.0".

12.4.2 Indicating Versions on Data

In each XML instance document conforming to *TransXChange,* the root ***TransXChange*** element has an attribute that is populated to indicate the schema version, as recommended by e-GIF. This allows any application which processes the document to decide how to handle the document. See *Table 12-2*. The Schema version is one of a standard set of Content change attributes that are specified on the route elements of all NaPT schemas.

Attributes	Value Type
CreationDateTime	Date and Time stamp, ISO format
ModificationDateTime	Date and Time stamp, ISO format
Modification	Nature of modification: one of n*ew, delete, revise*
RevisionNumber	Monotonically incrementing number
SchemaVersion	Schema Version number

Table 12-2 – TransXChange Document Version Attributes

12.4.3 Data Element Version

Most significant entities in *TransXChange* have an optional set of a standard change attributes on them, including a modification date and revision number that can be used to specify their version level. See *Table 12-3*.

Change Attributes	Value Type
CreationDateTime	Date and Time stamp, ISO format
ModificationDateTime	Date and Time stamp, ISO format
Modification	Nature of modification: one of n*ew, delete, revise*
RevisionNumber	Monotonically incrementing number

Table 12-3 – Entity Change Tracking Attributes

- Timestamps should be in standard ISO format, for example *'2004-04-14T14:20:00-05:00"*
- The ***RevisionNumber*** of an element should be incremented (and its ***Modification*** value be set to of *'revised'),* if any of its element values, attribute values or contained values is modified. It may be set to zero for a new entity.

12.4.4 Change Trackable Entities

The *TransXChange* entities which can be change tracked are shown in *Table 12-4*.

Entity	Versioning
TransXChange	SchemaVersion + **Change Attributes**.
StopPoint	**Change Attributes.**
StopArea	**Change Attributes.**
NptgLocality	**Change Attributes.**
FlexibleZone	**Change Attributes.**
Route	**Change Attributes**
RouteSection	**Change Attributes**
RouteLink	**Change Attributes**
Track	No – within ***RouteLink.***
JourneyPattern	**Change Attributes**
JourneyPatternSection	**Change Attributes**
JourneyPatternTimingLink	No – within ***JourneyPatternSection***
JourneyPatternStopUsage	No – within ***JourneyPatternSection.***
JourneyPatternInterchange	**Change Attributes.**
Operator	**Change Attributes.**
Service	**Change Attributes.**
Registration	**Change Attributes.**
Line	No – within **Service.**
VehicleJourney	**Change Attributes.**
VehicleJourneyTimingLink	No – No within ***VehicleJourney.***
VehicleJourneyInterchange	No – No within ***VehicleJourney.***
VehicleJourneyStopUsage	No – No within ***VehicleJourney.***
ServicedOrganisation	**Change Attributes.**
SupportingDocument	No

Table 12-4 – TransXChange Tracked Data Elements

Figure 12-2 shows the common TransXChange versioing attributes

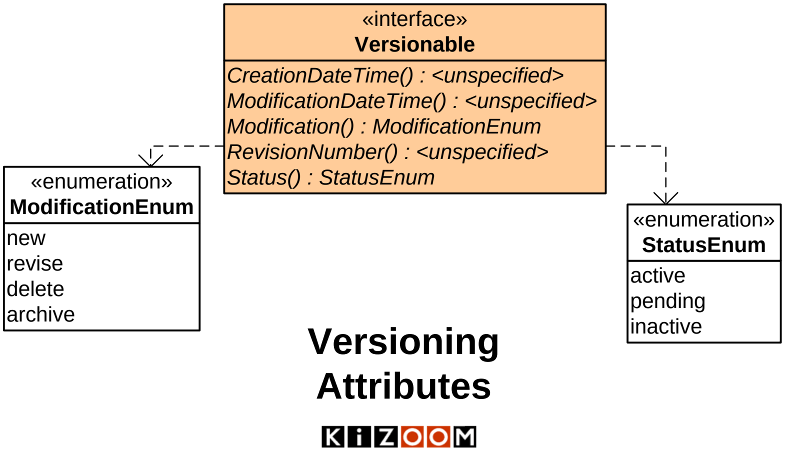


Figure 12-2 – UML Diagram of Versioning Attributes

12.5 Names of TransXChange Files

When dealing with a large number of bus schedules, it is helpful for document management if the file name used for a bus schedule when it is exchanged as an XML document gives an indication of its contents. The following format is recommended for file names of *TransXChange* XML documents:

Line_Operator_Area_ServiceCode_StartDate.xml

Where:

- *Line* is the service number seen by the public, as defined by a ***Service / Lines/ Line*** element within the document. If there is more than one ***Line*** associated with a service, use the first.
- *Operator* identifies the service operator and is either:
  - The operator code, i.e. ***RegisteredOperator*** / ***OperatorCode*** element for the service specified the within the document.
  - The operator license number, i.e. ***Operator*** / ***LicenceNumber*** of the operator registering the service.
- *Area* identifies the service area and is either:
  - *Area Code:* Three digit ATCO database code for the district/authority 450. This is the *NPTG* ***AdministrativeArea*** / ***AtcoAreaCode.***
  - *TAN Code:* Two character TAN prefix. This is the ***Registration*** / ***VosaRegistrationNumber / TanCode*** specified the within the document.
- *ServiceCode*- is an arbitrary unique identifier for the service as specified by a ***Service / ServiceCode*** element within the document.
- *StartDate*: Is the registered start date of the service as defined by a ***Service /OperatingPeriod /StartDate*** within the document.

So for example, the *757* service operated by *Aztecbird* (*AZT*) in *West Yorks* (450), the general TransXChange export file name would be:

Using the operator code:
757_AZT_450_4431_20020428.xml

Using the operator licence number:
757_3888_450_4431_20020428.xml

Using the Tan prefix on a registration:
757_3888_PB_4431_20020428.xml

For registrations there should generally be a separate file for each registration change date i.e. one file for the initial service, one for a new version of the service starting 01/07/2004 and so on.

When exchanging between the authority databases and journey planner and real time systems, multiple services may be contained in a single file, using the general schema. In this case there is no preferred naming scheming.

13 TRANSMODEL & TRANSXCHANGE COMPARISON

13.1 Transmodel Principles

TransXChange is based on *Transmodel*, a general abstract model for describing public transport information systems, devised on carefully elaborated informational science principles. Some of the key principles may be summarised as follows:

1. **Layered Semantic Models**: The efficient modelling of public transport information requires a number of distinct models, representing different levels of discourse. For example, (i) the geospatial location (i.e. map) layer, (ii) the network topology layer, (iii) the service pattern layer, (iv) the timed vehicle journey layer, (v) the operational running layer, etc.
2. **Projection**: It should be possibly to combine the different models in order to compute over them, relating the corresponding elements of different levels of discourse precisely and unambiguously, using a common frame of reference. For example, route links should map onto geospatial objects such as roads; timing links should map onto route links, etc. The establishment of equivalences between distinct model layers is termed *projection*.
3. **Common Terminology:** A standard set of common conceptual entities should be used for the elements making up the models at each different layer, and a standard *Transmodel* terminology should be used. For example, Line, Journey Pattern, Vehicle Journey, Location.
4. **Point and Link Structures**: Public Transport Information System models typically involve complex networks which are modelled in computer systems by graphs; that is, as networks of nodes (points) and edges (links). Depending on the information of interest in a particular application, it may be appropriate to use ordered collections of links, ordered collections of points, or combinations thereof. Links of a given type should only connect to points of the corresponding semantic level of discourse. Only one unambiguous sequence of points (whether modelled as a point sequence, or link sequence) may be used in a given journey or service pattern.
5. **Well-defined Data Systems**. Elements corresponding to external entities should be assigned unique identifiers from agreed data reference systems.

13.2 Transmodel Terminology

Wherever possible, *TransXChange* follows *Transmodel* terminology for PT concepts. The equivalences between some key *TransXChange* elements and their corresponding *Transmodel* concepts are shown in *Table 13-1*. Divergences are highlighted in bold.

Transmodel	***TransXChange 2.0***	***Previously 1.2***
ADMINSTRATVIE ZONE / AREA	Administrative Area	--
ACTIVITY	Activity	ActivityFlag
Alight	**Set down**	**Set down**
Board	**Pick up**	**Pick up**
BLOCK	Block	--
DAY TYPE	OperatingProfile / RegularDayType PeriodicDayType ServicedOrganisationDayType	DayType / GeneralOpClassification Periodic SchoolOp
DEAD RUN	DeadRun	--
DESTINATION DISPLAY	DestinationDisplay	DynamicDestinationDisplay
DISTANCE	Distance	Distance
DIRECTION	Direction	JourneyDirection
FARE STAGE	FareStage	--
FARE ZONE	FareZone	--
JOURNEY PATTERN	JourneyPattern	JourneyPattern
JOURNEY PATTERN TIMING LINK	JourneyPatternTimingLink	JourneyPatternTimingLink
JOURNEY PATTERN LAYOVER	JourneyPattern / Layover	
JOURNEY PATTERN RUN TIME	JourneyPattern / RunTime	DefaultRunTime
JOURNEY PATTERN WAIT TIME	JourneyPattern / WaitTime	DefaultWaitTime
LINE	Line	(ServiceId)
(FARE SECTION) (LINK SEQUENCE)	RouteSection	--
LOCATION	Location	**Geocode**
LOCATING SYSTEM	LocatingSystem	(Geodata system)
OPERATOR	Operator	Operator
PLACE	Place	**Locality**
ROUTE	**Track (**See 13.3.1)	--
ROUTE LINK	**TrackLink (**See 13.3.1)	--
RUN TIME	Run time	Run time
Section	Section	**--**
SERVICE	Service, StandardService FlexibleService	**OverallServiceDescription**
SERVICE PATTERN	**Route (**See 13.3.1	**Route**
SERVICE JOURNEY PATTERN LINK	**RouteLink (**See 13.3.1	**RouteLink**
SERVICE JOURNEY PATTERN INTERCHANGE	JourneyPatternInterchange	JourneyPatternInterchange
SERVICE JOURNEY INTERCHANGE	VehicleJourneyInterchange	VehicleJourneyInterchange
SITE	**Landmark**	**Landmark**
STOP POINT	StopPoint	**Stop**
STOP AREA	StopArea	**StopCluster**
TIMING LINK	(JourneyPattern) TimingLink	TimingLink
TIME DEMAND	TimeDemand	--
VALIDITY PERIOD	ValidityPeriod	ValidityPeriod
VEHICLE JOURNEY	VehicleJourney	VehicleJourney
VEHICLE JOURNEY TIMING LINK	VehicleJourneyTimingLink	VehicleJourneyTimingLink
VEHICLE JOURNEY RUN TIME	VehicleJourneyTimingLink / RunTime	RunTime
VEHICLE JOURNEY WAIT TIME	VehicleJourneyTimingLink / WaitTime	WaitTime
VEHICLE TYPE	VehicleType	VehicleType
VERSION	**(RevisionNumber)**	**(RevisionNumber)**
WAIT TIME	Wait time	Wait time
ZONE	FlexibleZone	--

Table 13-1 – Comparison of Key Transmodel Terms

13.3 Divergences from Transmodel

Version 2.0 of *TransXChange* converges significantly closer to *Transmodel,* but still contains a few significant differences in terminology that reflect *TransXChange* 1.2 usage, and the legacy of *TransXChange's* orginal ATCO CIF representation. (Note too that *Transmodel* has also been subject to further evolution during the period of development of *TransXChange*). In addition TransXChange introduces additional convenience elements for implementation which can mostly be considered as views which compound other elements; for example a ***StopUsage*** groups various attributes that cna be associated with either end of a ***TimingLink***. The main outstanding differences (which may possibly be reduced in future), are as follows:

- *Transmodel* uses the term ROUTE to denote a physical path taken by vehicles through the network, identifying the road sections or track section being used with each stage. A *Transmodel* ROUTE LINK corresponds more properly to the ***Track*** (ROUTE LINK) and ***Mapping*** (POINT IN ROUTE LINK) elements of the *TransXChange* model.

- The *TransXChange* ***Route*** and ***RouteLink*** are similar to a *Transmodel* SERVICE PATTERN, and SERVICE LINK, that is, an abstract journey pattern, identifying a unique sequence of STOP POINTs in order that define a possible journey for a line, regardless of any actual timings..

13.3.1 TransXChange Representation of Journey Patterns

Note that *TransXChange* does not use what *Transmodel* would term a STOP IN SEQUENCE (or more specifically, STOP POINT IN JOURNEY PATTERN) representation of a journey pattern, but rather a *Transmodel* LINKS IN LINK SEQUENCE representation; more specifically, a sequence of journey pattern timing links (TIMING LINK IN JOURNEY PATTERN). The *Transmodel* abstract model allows for a separate set of SERVICE LINKs between the stop points of a service pattern or journey pattern that is distinct from the set of TIMING LINKs of the pattern, permitting multiple timings to be specified for the same route, and for some of the intermediate timing points not to be stop points (and stop points not to be timing points). Because *TransXChange* has historically been primarily concerned with the exchange of fully timed schedules for registration, all points in a *TransXChange* JOURNEY PATTERN are stop points, and *TransXChange* uses only timing links: the existence of a service link between two points is implied from the existence of a timing link between two stops. This simplifies the mapping of the representation to a published matrix timetable, however a consequence is that it forces a false interpolation of run times in some usages. For example, if there is a sequence of non-timing stop points in a pattern, for which there is only an overall run time, the overall run time must be arbitrarily assigned to one or more of the intermediate links in order to encode it in *TransXChange*.

In effect TransXChange makes a simplifying assumption that all TIMING POINTs are in effect also STOP POINTs so is abloe to use a combined Link abstraction that has both timing and service pattern properties. The StopUsage element

It may be appropriate to add a compatible STOP IN SEQUENCE and separate service and timing link representations to a future version of TransXChange.

13.3.2 Abbreviated Journey Patterns

In *TransXChange,* two practical expedients are used also to reduce the amount of data that has to be exchanged, and in particular the number of journey patterns.

- a. *Short working* of the underlying journey pattern is allowed in *TransXChange*, i.e. truncation of one or more stops of the pattern at either or both ends. *Transmodel* indicates that a separate journey pattern should be declared for *any* difference in stop sequence, which could be strictly interpreted as requiring a separate journey pattern for each short working vehicle journey variant.

- b. *Express* journeys over a service pattern are allowed in *TransXChange* – i.e. provided a journey traverses a link, and goes past a stop, it may specify an activity of 'pass' to omit a particular stop.

In both the above cases, there is little or no informational benefit to having a separate journey pattern, and there is in any case little distinction between the above cases and the legitimate *Transmodel* representation of a vehicle following a 'full' journey pattern in real-time that for operational reasons passes stops, or terminates early.

13.3.3 Groups of Links

Another expedient *TransXChange,* uses to reduce the amount of data that has to be exchanged is a "link section", that is, a reusable ordered list of Links that can be reused in one or more ROUTEs or JOURNEY PATTERN. This is partiucallry useful where there is corridor route with a long common section but many end variants. Link sections are an additional abstraction not found in Transmodel but can be seen as equivalent to GROUP OF LINKs being used in a specific way. Their use amounts to a requirement that there is always at least one "GROUP OF LINKS" associated with each journey pattern., but need not conflict in any way with a canonical Transmodel represnetation.

14 INTEGRITY RULES

14.1 Syntactic Integrity Rules

XML's inbuilt mechanisms, including *Keyrefs* are used in the *TransXChange* schema to enforce a number of basic integrity checks of data within a *TransXChange* document, including enforcing uniqueness. A document must satisfy these constraints, or it is not well formed and will not be processed further by the *TransXChange Publisher* or other tools.

- Data types are specified for dates, times, durations and other common data types.
- Restricted values are enforced by enumerations – see individual tables of allowed values under the schema guide entry for constrained elements.
- Some additional rules for encoding formatted elements are enforced by regular expressions.
- *Table 14-1* shows the other rules enforced by syntactic constraints.

Group	Element	#	Scope	Reference
Code Scope	***AtcoCode***	C1	Codes of local ***StopPoint*** declarations must be unique within document.	***StopPointRef*** instances must reference a ***StopPoint*** or ***AnnotatedStopPoint*** declaration. See also External Integrity rule N1.
	StopAreaCode	C2	Codes of local ***StopArea*** (Cluster) declarations must be unique within document.	***StopAreaRef*** – See External Integrity rule N2.
	ServicedOrganisationCode	C3	Codes of ***ServicedOrganisation*** declarations must be unique within operator.	***ServicedOrganisationRef*** instances must reference a local definition of a ***ServicedOrganisation*** element.
	ServiceCode	C4	***Code*** of each ***Service*** must be unique within document.	***ServiceRef*** instances must refer to a local definition of a ***Service***.
	VehicleJourneyCode	C5	***Code*** of each ***VehicleJourney*** & ***FlexibleVehicleJourney*** must be unique within document.	***VehicleJourneyRef*** instances must reference a local definition of a ***VehicleJourney***.
	GarageCode	C6	Codes of Garage declarations must be unique within document.	***GarageCodeRef*** instances to a Garage must reference a local definition of a Garage element.
Identifier Scope	***Route / id***	I1	***id*** of each ***Route*** must be unique within document.	***RouteRef*** instances must reference a local definition of a Route.
	JourneyPattern /id	I2	***id*** of each ***JourneyPattern*** must be unique within document.	***JourneyPatternRef*** instances must reference a local definition of a ***JourneyPattern***.
	Line / id	I5	***id*** of each ***Line*** must be unique within document.	***LineRef*** instances must refer to a local definition of a ***Line*** element.
	RouteSection / id	I6	***id*** of each ***RouteSection*** must be unique within document.	***RouteSectionRef*** instances must refer to a local definition of a ***RouteSection***.
	JourneyPatternSection / id	I7	***id*** of each ***JourneyPatternSection*** must be unique within document.	***JourneyPatternSectionRef*** instances must refer to a local definition of a ***JourneyPatternSection***.
	RouteLink/ id	I8	***id*** of each ***RouteLink*** must be unique within document.	***RouteLinkRef*** instances must reference a local definition of a ***RouteLink***.
	JourneyPatternTimingLink / id	I9	***id*** of each ***JourneyPatternTimingLink*** must be unique within document.	***JourneyPatternRef*** instances must reference a local definition of a ***JourneyPatternTimingLink***.
	VehicleJourneyTimingLink / id	I10	***id*** of each ***VehicleJourneyTimingLink*** must be unique within document.	***VehicleJourneyRef*** instances must reference a local definition of a ***VehicleJourneyTimingLink***.

	VehicleJourneyStopUsage / id	I11	***id*** of each ***VehicleJourneyStopUsage*** must be unique within document.	***VehicleJourneyStopUsageRef*** instances must refer to a local definition of a ***VehicleJourneyStopUsage***.
	VehicleJourneyStopUsage / id	I12	***id*** of each ***VehicleJourneyStopUsage*** must be unique within document.	***VehicleJourneyStopUsageRef*** instances must refer to a local definition of a ***VehicleJourneyStopUsage***.
Cyclic	***VehicleJourneyRef***	X1	***VehicleJourney*** must not reference itself.	

Table 14-1 – Syntactic Integrity Rules

14.2 Semantic Integrity Rules

Table 14-3 shows additional integrity rules that need to be applied by applications parsing a *TransXChange* XML document. These are subdivided into two categories:

- *Intrinsic Constraints:* Consistency checks that can be applied without reference to external data. For many of these, a sensible recovery action can be taken.
- *Extrinsic Constraints:* Checks of data values that require reference to an external source. Whether these need to be applied depends on the availability of the relevant data sets, and the purpose of the application.

Rules are assigned a severity (see *Table 14-2*) that indicates the likely action that an application such as *TransXChange Publisher* will take if the rule is not satisfied.

Rules that may affect the correct publishing of a document by the *TransXChange* Publisher are marked with a ‘p’.

Severity	Meaning	Action
1	Fundamental Inconsistency – Schedule cannot be accurately interpreted.	Report as serious error. Reject for registration.
2	Inconsistency – Default Remedial action possible, but statutory Registration requires clarification.	Report, apply remedy automatically. Reject for registration.
3	Inconsistency – Default Remedial action possible.	Report, apply remedy automatically.
4	Data reference does not exist in external source.	Report as missing.
5	Ancillary data reference does not exist.	Report as missing.
6	Minor data inconsistency.	Report, leave uncorrected.

Table 14-2 – Severity Codes for Semantic Integrity Rules

Group	#	Rule Name	Description	Cat	Sev	Remedy
Metadata	Dc1	Valid FileName	File name is made up of recommended elements.	Int	6	Allow, but give warning.
NaPTAN	Na1	Valid *NaPTAN* Stop Identifiers.	Stop points referenced by an ***AnnotatedStopPointRef*** must exist in the *NaPTAN* database.	Ext	4	Warning.
	Na2	Valid *NaPTAN* StopArea Identifiers.	Stop areas referenced by a ***StopAreaRef*** of a local StopPoint definition must exist in the *NaPTAN* database, or be defined locally.	Ext	4	Warning.
	Na3	Local *NaPTAN* StopAreas .	Stop areas referenced by a ***StopAreaRef*** of a local ***StopPoint*** definition should belong to the same Admin Area as the ***StopPoint*** or to a national area e.g. 910.	Ext	6	Warning.
	Ng3	Valid *NPTG* Localities.	*NPTG* localities referenced by ***NptgLocalityRef*** of local ***StopPoint*** definition must exist in the *NPTG* database.	Ext	4	Warning.
	Ng4	Valid *NPTG* Administrative Areas.	*NPTG* administrative areas referenced by an AdministrativeAreaRef of local stop point definition must exist in the *NPTG* database.	Ext	4	Warning.
Serviced Organization	Eo1	Valid Serviced Organizations.	For local authorities, should be a valid DfE LEA code. For schools, should be a valid DfE school code.	Ext	5	Warning.

	Eo2	Serviced Organization no cyclic References.	Parent or ancestor should not be self.	Int	3	Ignore parent.
Period	Tp1	Unique Operation Profile weeks.	***PeriodicDayType/ Weeks*** should be distinct.	Int	3,*q	Ignore overlap.
	Tp2	Valid Date Ranges.	***End date*** should be after ***start date*** on ***ValidityPeriod*** and other ranges.	Int	3,*q	Use start date for both, and report.
	Tp3	Distinct Periods.	Periods for exclusion suspension should not overlap.	Int	3	Ignore 2nd period.
	Tp4	Valid Dates	Calendar Dates should lie within Service Operational period	Int	3,*q	Assume within operational period.
Operator	Op1	National Operator Code.	***NationalOperatorCode*** should be valid in future database.	Ext	4	Allow.
	Op2	Distinct Operator References.	***RegisteredOperator*** of a Service should not be the same as A***ssociatedOperator***.	Int	3	Ignore associated operator.
	Op3	Distinct Associated Operator roles.	Each ***AssociatedOperator*** should only be referenced once by a given service for a given role.	Int	6	Ignore duplicate references.
	Op4	Valid garage code.	***GarageCode*** should be valid for Operator.	Int	6	Allow.
Service	Sv1	Flexible Service type.	If ***FlexibleService*** component present, ***ServiceClassification*** should include ***Flexible***.	Int	6	Assume Flexible Type.
	Sv2	Appropriate Service type.	The following combinations of ***ServiceClassification*** are not allowed. • ***NormalStopping*** and any other type except ***RuralService***. • ***ExcursionOrTour*** and any other type.	Int	**2**	Reject
	Sv3	New stops.	Local stops declared, but registration not flagged as requiring new stops.	Int	3	Assume requires new stops.
	Sv4	Missing Map.	***Service / SchematicMap*** is specified but file not found.	Int	3,*q	Warning.
	Sv5	New short notice application can't exceed change limit.	if ***Service / ApplicationClassification***> is ***start*** then ***ChangeExceedsLimit*** cannot be true.	Int	3,*q	Warning.
Route	Rs1	Linear routes.	In a sequence of ***RouteSection*** instances making up a given ***Route***, the ***To*** / ***StopPoint*** of the last link of a given ***RouteSection*** should be the same as the ***From*** / ***StopPoint*** of the first link of the succeeding ***RouteSection*** in the ***Route***.	Int	**1,** p	Reject.
	Rs2	Route section link direction.	All route links in a route section should have the same ***Direction.***	Int	6, p	Use first direction found.
	Rs3	Route Direction Antithesis.	For a given ***Service***, any explicit direction values on routes should be an antithetical pair, i.e. Outbound/Inbound, Clockwise/Anticlockwise.	Int	6	Treat Clockwise as Outbound.
	Rl1	Route Link sequence stop references.	In a collection of successive route links, 'To' stop point reference of previous link should be same as 'From' stop reference of next successive link.	Int	3, p	Ignore second usage.
	Rl2	Route Link distinct endpoints.	'From' and 'To' stop points of a ***RouteLink*** should be distinct, i.e. not the same	Int	6	Allow, but issue warning.

	Rl3	Track end points constrained to route.	First and last points of ***Track*** mapping should correspond (i.e. be near to) stop points of parent ***RouteLink***.	Int	3	Ignore points.
	R14	Stop Type Usage	Within a given route Fixed stops (i.e. stops of type MKD) should not fall within the area of Hail and Ride stops (i.e. stops of type HAR)	Int	2	Report as disallowed
Journey Pattern	Jp1	Timing endpoints.	Start and end stops of a journey pattern should have a ***StopType TimingStatus*** of principle point.	Int	4, p	Treat as PTP regardless.
	Jp2	Distinct journey pattern Interchange References.	Inbound and outbound journey patterns at an interchange should normally be distinct.	Int	6	Allow, but give warning.
	Jp3	Journey pattern Direction.	***JourneyPattern*** / ***Direction*** should correspond to one of the ***Service*** direction values. If ***Service*** has only a single direction value, the ***JourneyPattern*** / ***Direction*** should match. If the ***Service / Direction*** has a value of *circular* or *inboundOrOutbound* then JourneyPattern must supply an explicit override rather than using a value of *inherit*?	Int	3	Use Journey Pattern value
	Jps1	Section Projection.	If there are route sections, then for each ***JourneyPatternSection,*** there should be a corresponding ***RouteSection*** with the same number of links.	Int	**1**	Reject.
	Jps2	Linear journey patterns.	In a sequence of ***JourneyPatternSection*** instances making up a given ***JourneyPattern***, the ***To*** / ***StopPoint*** of the last link of a given ***JourneyPatternSection*** should be the same as the ***From*** / ***StopPoint*** of the first link of the succeeding ***JourneyPatternSection*** in the ***JourneyPattern***.	Int	**1**, p	Reject.
	Jptl1	Journey Pattern timing link sequence stop references.	In a collection of successive timing links, 'To' stop reference of previous link should be same as 'From' stop reference of next successive link.	Int	6, p	Ignore second usage.
	Jptl2	Journey Pattern timing link distinct endpoints.	'From' and 'To' stops of a timing link should be distinct, i.e. not the same	Int	6	Allow.
	Jptl3	Route Link Projection.	If a ***JourneyPatternTimingLink*** references a ***RouteLink,*** the start and end stops of both links should correspond. If the ***Direction*** of the ***JourneyPatternTimingLink*** is the same as that of the ***RouteLink***, the respective start points should be the same and the respective ends point should be the same. If the ***Direction*** is opposite, the ***JourneyPatternTimingLink*** start point should match the ***RouteLink*** end point, and vice versa.	Int	**1, p**	Reject
	Jptl4	Start and end activity of journey pattern timing link.	Start activity of first stop of a ***JourneyPattern*** should be pickup only; activity of last stop should be set down. Unless route is circular, or stop connects at a ***JourneyPatternInterchange***.	Int	6	Assume.
	Jptl5	Fare stages consistent with zone numbers.	The ***FareStage*** flag on stop usage of a from stop usage element should be set to reflect any change in ***FareStage*** zone numbers.	Int	6	Assume zone numbers are correct.

	Jptl65	RunTime should be greater than zero.	Only in exceptional cases (e.g. physically adjacent stops) should a timing link run time be zero	Int	6	Allow
Vehicle Journey	Vj1	Cyclic vehicle journey references.	Referenced ***VehicleJourney*** for link usage should not be self, either directly or indirectly.	Int	3, p	Ignore reference.
	Vj2	Vehicle journey link references.	If a ***VehicleJourney*** references a ***VehicleJourney*** for its link usage, there should be no ***VehicleJourneyTimingLink*** instances present for the referencing journey.	Int	3, p	Ignore links in referencing journey.
	Vj3	Mixed Frequency Group	In a group of journeys with the same end making up the same frequent service period, not all vehicle journeys in the group have the same minimum, maximum and scheduled frequencies or minute spast the hour.	Int	3, p	Use values from first
	Vj4	Vehicle journey direction.	Vehicle journey ***Direction*** should be same as the journey pattern ***Direction***.	Int	6	Ignore and use journey pattern value.
	Vj5	Conflicting Frequency Group	In a group of journeys with the same end making up the same frequent service period, either all journeys must use scheduled frequencies or all journeys must use minutes pas the hour. A mixture is not allowed.	Int	3, p	Use values from first
	Vji1	Distinct interchange references.	Inbound and outbound vehicle journeys of an interchange should be distinct.	Int	3,*q	Allow, but give warning.
	Vji2	Matching interchange journeys.	The vehicle journeys referenced by a ***VehicleJourneyInterchange*** should be dependents of the corresponding inbound and outbound journey patterns referenced by the ***JourneyPatternInterchange*** that the ***VehicleJourneyInterchange*** references.	Int	3	Reject Interchange.
	Vjtl1	Vehicle journey timing link projection.	For each ***VehicleJourneyTimingLink*** there should be a corresponding ***JourneyPatternTimingLink.***	Int	**1**	Reject.
	Vjtl2	Start and end activity of vehicle journey timing link.	Start activity of first stop of a ***VehicleJourney*** should be pickup only; activity of last stop should be set down. Unless route is circular, or stop connects at a ***VehicleJourneyInterchange***.	Int	3,*q	Assume.
	Vjtl3	Short working reference.	Any ***ShortWorking*** / ***JourneyPatternTimingLinkRef*** instances should reference a timing link of the vehicle journey that contains it.	Int	3, p	Ignore short working.
	Vjpl1	Positioning link distinct endpoints.	From and to points of a positioning link should be distinct**.**	Int	3,*q	Ignore positioning link.
	Vjpl2	Positioning link stop point.	One end of a positioning link sequence should reference a stop in the journey pattern.	Int	3, p	Ignore positioning link sequence.
	Vjpl3	Positioning link reference.	Positioning link references should be valid. Any ***GarageRef*** instances referenced by a positioning link should belong to the ***Service Operator***. Any ***Garage*** Ref, ***LayoverRef*** instances referenced by a positioning link should belong to the ***JourneyPattern.***	Int	3	Ignore positioning link.

Table 14-3 – Intrinsic & Extrinsic Semantic Integrity Rules

14.3 Ordered Relationships

Table 14-4 shows the relationships in *TransXChange* whose order is semantically significant.

From	To	Note
Route	***RouteSection***	Section sequence → Link sequence
RouteSection	***RouteLink***	Route link sequence
JourneyPattern	***JourneyPatternSection***	Section sequence → Link sequence
JourneyPatternSection	***JourneyPatternTimingLink***	Journey Pattern Timing link sequence
VehicleJourney	***VehicleJourneyTimingLink***	Vehicle Journey Timing link sequence
DeadRun	***PositioningLink***	Positioning link sequence
TransXChange	***VehicleJourney***	Journey ordering
RouteLink	***Track***	Track sequence
Track / Mapping	***Location***	Arc of path
Track / Instructions	***Feature***	Steps to traverse track
StopPoint /../ FlexibleZone	***Location***	Bounding box of points
FlexibleJourneyPattern	***FlexibleZones***	Order of visiting zones

Table 14-4 – Ordered Relationships

14.4 Precedence Rules for Combining General Date Elements

Table 14-5 shows the elements governing service dates, in order of precedence. Where elements cover the same day types or date ranges, higher precedence elements are used in preference to lower precedence elements. Data conflicts that are considered validation errors are indicated in a few cases.

Seq	Element		Description	Effect	Error	Sev
1.	Service Period	***Po1***	***Service / OperatingPeriod***			
2.	Vehicle Journey Interchange	***Vi1***	***VehicleJourney / VehicleJourneyInterchange/ ValidityPeriod,***	exclude	T4 Outside of ***Service / OperatingPeriod***	2
3.	Vehicle Journey Special	***Vx1***	***VehicleJourney / OperationProfile / SpecialDaysOperation / DaysOfNonOperation.***	exclude	T4 Outside of ***Service / OperatingPeriod***	2
4.		***Vx2***	***VehicleJourney / OperationProfile / SpecialDaysOperation / DaysOfOperation,***	include	T4 Outside of ***Service / OperatingPeriod***	2
5.		***Vx3***	***VehicleJourney / OperationProfile / BankHolidayOperation / DaysOfNonOperation.***	exclude		
6.		***Vx4***	***VehicleJourney / SpecialOperationProfile / BankHolidayOperation / DaysOfOperation.***	include		
7.	Vehicle Journey Normal	***Vn1***	***VehicleJourney / OperationProfile / ServicedOrganisationDayType / DaysOfNonOperation***	exclude	T4 Outside of ***Service / OperatingPeriod***	2
8.		***Vn2***	***VehicleJourney / OperationProfile / ServicedOrganisationDayType, DaysOfOperation***	include	T4 Outside of ***Service / OperatingPeriod***	2
9.		***Vn3***	***VehicleJourney / OperationProfile / ServicedOrganisationDayType ServicedOrganisation / DaysOfNonOperation*** for the serviced organisations ancestors, as specified by ***ServicedOrganisation / ParentRef.***	exclude		
10.		***Vn4***	***VehicleJourney / OperationProfile / ServicedOrganisationDayType,*** of ***ServicedOrganisation / DaysOfOperation*** for the serviced organisations ancestors, as specified by ***ServicedOrganisation / ParentRef.***	include		
11.		***Vn5***	***VehicleJourney / OperationProfile / PeriodicDayType / WeekOfMonth.***	exclude		
12.		***Vn6***	***VehicleJourney / OperationProfile / RegularDayType / Days.***	include		

13	Journey Pattern Special	***Jx1***	***JourneyPattern / OperationProfile / SpecialDaysOperation / DaysOfNonOperation.***	exclude	T4 Outside of ***Service / OperatingPeriod***	2
14.		***Jx2***	***JourneyPattern / OperationProfile / SpecialDaysOperation / DaysOfOperation,***	include	T4 Outside of ***Service / OperatingPeriod***	2
15.		***Jx3***	***JourneyPattern / OperationProfile / BankHolidayOperation / DaysOfNonOperation.***	exclude		
16.		***Jx4***	***JourneyPattern / SpecialOperationProfile / BankHolidayOperation / DaysOfOperation.***	include		
17.	Journey Pattern Normal	***Jn1***	***JourneyPattern / OperationProfile / ServicedOrganisationDayType / DaysOfNonOperation***	exclude		
18.		***Jn2***	***JourneyPattern / OperationProfile / ServicedOrganisationDayType, DaysOfOperation***	include		
19.		***Jn3***	***JourneyPattern / OperationProfile / ServicedOrganisationDayType ServicedOrganisation / DaysOfNonOperation*** for the serviced organisations ancestors, as specified by ***ServicedOrganisation / ParentRef.***	exclude		
20.		***Jn4***	***JourneyPattern / OperationProfile / ServicedOrganisationDayType,*** of ***ServicedOrganisation / DaysOfOperation*** for the serviced organisations ancestors, as specified by ***ServicedOrganisation / ParentRef.***	include		
21.		***Jn5***	***JourneyPattern / OperationProfile / PeriodicDayType / WeekOfMonth.***	exclude		
22.		***Vn6***	***JourneyPattern / OperationProfile / RegularDayType / Days.***	include		
23.	Journey Pattern Interchange	***Ji1***	***Service / JourneyPatternInterchange / ValidityPeriod,*** outside of range of ***Service / OperatingPeriod***	exclude		
24.	Service Profile	***Sx1***	***Service / SpecialOperationProfile / SpecialDaysOperation / DaysOfNonOperation***	exclude	T4 Outside of ***Service / OperatingPeriod***	2
25.		***Sx2***	***Service / SpecialOperationProfile / SpecialDaysOperation / DaysOfOperation***	include	T4 Outside of ***Service / OperatingPeriod***	2
26.		***Sx3***	***Service / SpecialOperationProfile / BankHolidayOperation / DaysOfNonOperation***	exclude		
27.		***Sx4***	***Service / SpecialOperationProfile / BankHolidayOperation / DaysOfOperation***	include		
28.	Service Normal Profile	***Sn1***	***Service / OperationProfile / ServicedOrganisationDayType / DaysOfNonOperation***	exclude		
29.		***Sn2***	***Service / OperationProfile / ServicedOrganisationDayType, / DaysOfOperation***	include		
30.		***Sn3***	***Service / OperationProfile / ServicedOrganisationDayType,*** of ***ServicedOrganisation / DaysOfNonOperation*** for the serviced organisations ancestors, as specified by ***ServicedOrganisation / ParentRef.***	exclude		
31.		***Sn4***	***Service / OperationProfile / ServicedOrganisationDayType,*** of ***ServicedOrganisation / DaysOfOperation*** for the serviced organisations ancestors, as specified by ***ServicedOrganisation / ParentRef.***	include		
32.		***Sn5***	***Service / OperationProfile / PeriodicDayType / WeekOfMonth.***	exclude		
33.		***Sn6***	***Service / OperationProfile / RegularDayType / Days.***	include		

Table 14-5 – Date Elements in Order of Precedence

15 APPENDIX A – REFERENCES TO OTHER STANDARDS

15.1 Transport Domain

15.1.1 NaPTAN & NPTG

National Public Transport Access Nodes (NaPTAN) database; NaPTAN seeks to assemble and maintain a single source of information on the location and naming of bus stops and other public transport access nodes in England, Wales and Scotland. http://www.traveline.org.uk/naptan/

	UK Department for Transport Integrated Transport CREATING THE JOURNEYWEB NETWORK Deliverable Number 04-5 NaPTAN Specification v1.0 National Public Transport Access Nodes (NaPTAN) Database http://www.traveline.org.uk/naptan/naptan-4.5-Specification-v1.0b97.doc	2002 Nov	WS Atkins
	http://www.naptan.org.uk/schema/1.1/NaPtan_all_1.1.zip	Jan 2000	
	UK Department for Transport NaPTAN & NPTG Schema User Guide 2.0b	July 2004	Carlbro/Kizoom
	http://www.naptan.org.uk/schema/2.0c		

15.1.2 JourneyWeb

JourneyWeb is a UK Department for Transport sponsored protocol which defines a national data standard for the dynamic interchange of transport information, including journey plans, and timetables. It is used by the Transport Direct Portal project.

	UK Department for Transport JourneyWeb 3.0a Schema USER GUIDE http://www.kizoom.com/standards/journeyweb/schema/schemas.htm	2004 Jan	Kizoom

15.1.3 Transmodel CEN TC 278

Transmodel is a European Union sponsored abstract standard for describing Public Transport Information Systems.

	French Ministry for Transport REFERENCE DATA MODEL FOR PUBLIC TRANSPORT [CEN01] CEN TC278, Reference Data Model For Public Transport, ENV12896 revised, June 2001. [CEN97] CEN TC278, Road Transport and Traffic Telematics - Public Transport -Reference Data Model, prENV 12896 , May 1997 http://www.Transmodel.org	2004 Jan	Kizoom

15.2 Software & General

15.2.1 XML Schema

http://www.w3.org/XML/Schema

	XML Schema Part 0: Primer http://www.w3.org/TR/2001/REC-xmlschema-0-20010502/	2001 May 2	David C. Fallside
	XML Schema Part 1: Structures http://www.w3.org/TR/2001/REC-xmlschema-1-20010502/	2001 May 2	Various
	XML Schema Part 2: Datatypes http://www.w3.org/TR/2001/REC-xmlschema-2-20010502/	2001 May 2	Paul V. Biron and Ashok Malhotra

15.2.2 ISO Time Formats

	D ISO 8601 Date and Time Formats. http://www.w3.org/TR/xmlschema-2/ – isoformats	2001 May 2	W3C Various
	ISO8601:2000(E) Data elements and interchange formats – Information interchange –	2000 Dec 15	Louis Visser

	Representation of dates and times Second edition 2000-12-15 http://lists.ebxml.org/archives/ebxml-core/200104/pdf00005.pdf		

15.2.3 WGS 1984 Location Referencing

	World Geodetic Standard 1984 http://www.wgs84.com/		W3C Various

15.2.4 ISO 639-1 Names of Languages

	ISO 639-1:2001. Code for the representation of the names of languages http://www.oasis-open.org/cover/iso639a.html		Infoterm

15.2.5 Rfc 1766 Tags for the Identification of Languages

	rfc1766 – Tags for the Identification of Languages http://www.ietf.org/rfc/rfc1766.txt		Infoterm

15.2.6 GovTalk XML Coding Standards

GovTalk sets out standards for exchange of data in XML

	Office of the e-Envoy **Schema Guidelines** **Best Practice Advice Version 2** **http://www.govtalk.gov.uk/documents/Schema Guidelines 2.doc**	2002 Oct 12	Paul Spencer
	e-Government Metadata Standard e-GMS1.0 http://www.govtalk.gov.uk/documents/e-Government_Metadata_Standard_v1.pdf	2002 Apr	Office of e-Envoy

15.2.7 UML Unified Modelling Language

Unified Modelling Language is a notation for describing software models managed by the Object Management Group.

	Unified Modelling Language (UML), version 1.5 http://www.omg.org/technology/documents/formal/uml.htm	formal/2003-03-01	OMG

16 APPENDIX B - NEW FUNCTIONS IN TRANSXCHANGE 2.0 & 2.1

Table 16-1 summarises the changes to *TransXChange* included in Version 2.0:

Group	Item	Ross Dixon Review	Additional work undertaken
Review Compatibility with other standards	Naptan	[4.3]	Yes
	NPTG	[4.4]	Yes
	JourneyWeb	[4.2]	Yes
	RTIG/ SIRI	[4.5]	
	Compatibility with Transmodel	[4.1]	Yes
Internal review	Modularisation	[4.12]	Yes
	Schema Style & XML best practice	[4.31]	Yes
	Versioning	[4.31]	Yes
	Complex Content Models	[4.22]	Yes
Corrections, and small features	Field Length Truncation	[4.23]	
	ID and IDREF Datatypes	[4.21]	Yes
	Seconds in units of Time	[X2]	
	Route Segments	[4.29]	Yes
	Days of Operation Modification	[4.13]	Yes
	Grid References	[4.19]	Yes
	Registration Number Modification	[4.12]	Yes
	Reconciliation of JourneyPattern and VehicleJourney Definitions	[4.14]	Yes
	Data Integrity	[4.24]	Yes
	e-Gif	[4.7]	Yes
	Welsh Language	[4.25]	Yes
	Bank Holidays	[4.26]	Yes
New Function	New National Operator code	[X3]	
	Vehicle Operations	[4.27]	Yes
	Serviced Organisation / School Dates	[4.28]	
	Impact of Forthcoming Regulations for Flexibly Routed Services	[4.8]	
	Fare stages	[4.30]	Yes
	Dead Runs	[X5]	Yes
	Dynamic Bay Allocation	[X6]	Yes
	Direct Timetable Representation	[4.15]	Yes
	Enable for Connecting Services	[X7]	Yes
	Improve service description: Add Vias, PublicUse, Availability, Reversing Manoeuvres, StopNote, etc	[X9]	Yes
	Add extra publisher functions	[X10]	Yes
	Remove legacy elements & update	[X11]	Yes
Validation	Test Files	[4.16]	
	Data integrity checks	[4.24]	Yes
	Validation rules	[4.11]	Yes
	Forward Compatibility with TransXChange Processing Infrastructure	[4.10]	Yes
Style sheets	Consequential Modification	[4.9]	Yes
Documentation	Advice to Receivers and Users of TransXChange Data	[4.11]	Yes
No action	Enumeration Case Sensitivity	[4.18]	--
	Compatibility with TRIDENT	[4.6]	--
	Digital Signatures	[4.20]	--

Table 16-1 – Main Changes in TransXChange 2.0 from TransXChange 1.2

16.1 Changes in 2.1

- NptgLocality Names cane be specified for new stops using a AnnotatedNptgLocalityRef
- StopPoint Landmark and Street are now optional

17 APPENDIX C – COMPARISON OF TERMINOLOGY TRANSXCHANGE 2.0

The following table compares terminology used in TransXChange 2.0 with terminology in ATCO CIF & with the AIM exchange format

TransXChange 2.x(Transmodel)	**ATCO-CIF**	**AIM (new model)**
Service	Route	ServiceRegistrationGroup
Line	Service	Service
JourneyPattern	-	TripTemplate
JourneyPatternSection	-	TripTemplateSection
VehicleJourney	Journey	Trip
Route	(Track)[1]	Path
RouteSection	-	PathSection
RouteLink	(Segment)	PathSegment
Track	(Step)	PathStep
Interchange[2]	Connection	Connection

Table 17-1 – Terminology Cross-Reference

[1] Applies to AIM ATCO-CIF extension

[2] Interchange has historically been used as a noun to describe a collection of access nodes. This has included any fixed attributes relating to alighting at one node then boarding at another. The TransXChange 2 terminology is quite different because it refers to the journey-related attributes associated with changing vehicle