

Trusting the numbers

How does bus real time information work?

read on



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Navigating this interactive Guidance

This contents page is *interactive* so simply click on the page you would like to go to on the left of this text.

You can use the tools shown below to move interactively through our report and return to this page.

Page navigation

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Use clickable navigation at top of each page on the right-hand side to move forwards and backwards through the Guidance.

Section navigation

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Clickable navigation at the top of the page to take you to individuals sections of the Guidance.

In-page diagram navigation

Live bus prediction diagram navigator

STEP 1

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◀◀

▶▶

Click each numbered step beneath each diagram in each user section to step through the parts of the RTI diagram most relevant to that user type.

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Design

Designed and produced by [DEFT153](#).

Page: 2 • How does bus Real Time Information work?

Trusting the numbers

Overview:

What is Real Time Information (RTI)?

What is RTI?

RTI stands for Real Time Information. For bus services, RTI shows what time a bus is predicted to be at a given location — such as a bus stop — on electronic signs,

journey planners and other online sources of information. People use RTI for planning and making journeys across the various modes of transport available to them.

RTI has largely replaced the printed timetable as the key source of information on what journeys, routes and travel times are possible in order to make a journey. This is made possible by:

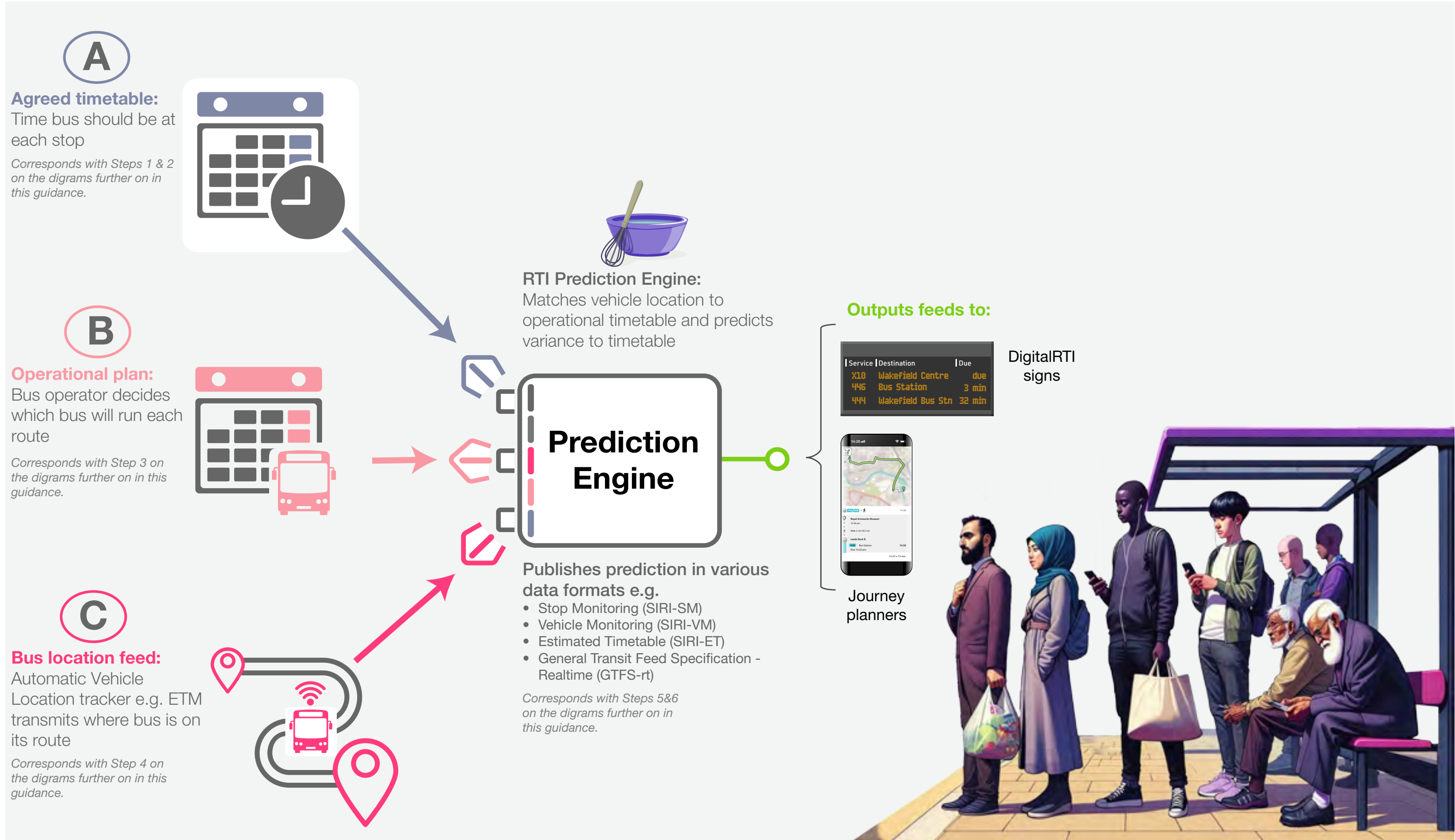
- the availability of journey planner apps on smart phones;
- the roll out of digital signs at transport stops.

RTI is critical to making and planning a successful bus journey on a dynamic transport network because multiple issues can affect the punctuality of a bus.

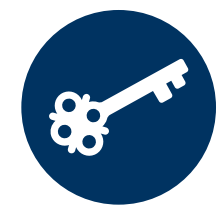
People want to know: “how many minutes away is my bus?”, not “what timetable was my bus was supposed to be running to.” This is confirmed in the [findings](#) of Transport Focus’s annual longitudinal study on bus customer satisfaction.

What needs to be in place for RTI to work?

The diagram opposite shows the various components that need to be in place so that a bus customer gets the information they need in order to act upon it.



The Key Concepts section of this
Guidance covers the various aspects of
RTI and its dependencies



RTI Key Concepts:

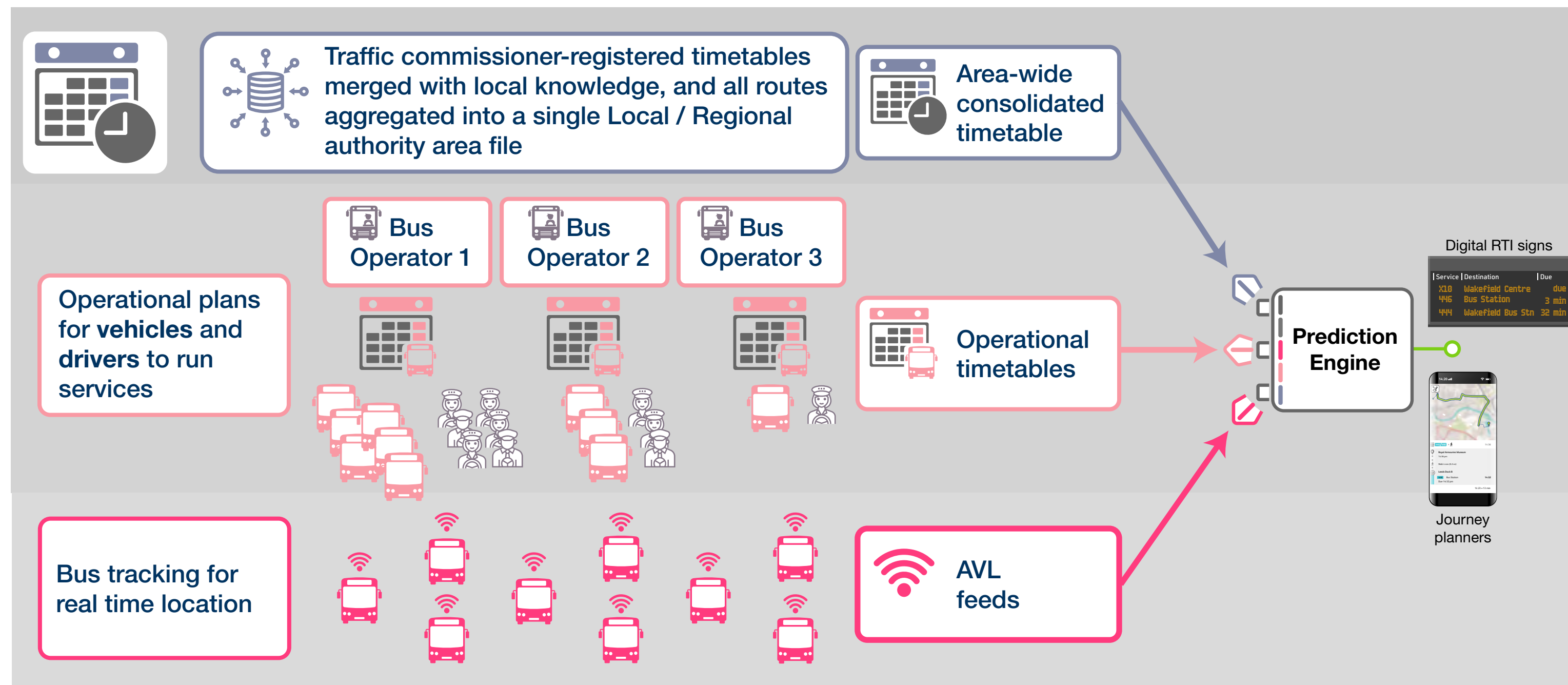
1. Simple presentation is supported by a complex ecosystem

Simple presentation

Real time Information is presented to bus customers through simple interfaces focused on conveying information to them quickly and simply.

Complex ecosystem

This simple presentation conceals the complex systems, operations and workflows that these interfaces depend upon. Exploring this complexity can help to explain why the information that bus customers see is not always accurate.



Predicting an individual bus time at a specific bus stop presents a classic needle in a haystack challenge, because there are there are:

- More than 30,000 public bus operator vehicles;
- Nearly 9,000 registered bus routes;
- More than 3.63 billion bus journeys each year.

Source: Department for Transport, March 2023
Scope: Great Britain



RTI Key Concepts:

2. Customers get bus times from multiple sources

Information from different sources may not match

Because bus times are sourced from different supply chains, customers may see departure times on a digital bus stop sign that differ from the times shown on a journey planner app. Different apps also do not always show the same times.

Sources include:

Digital bus stop signs

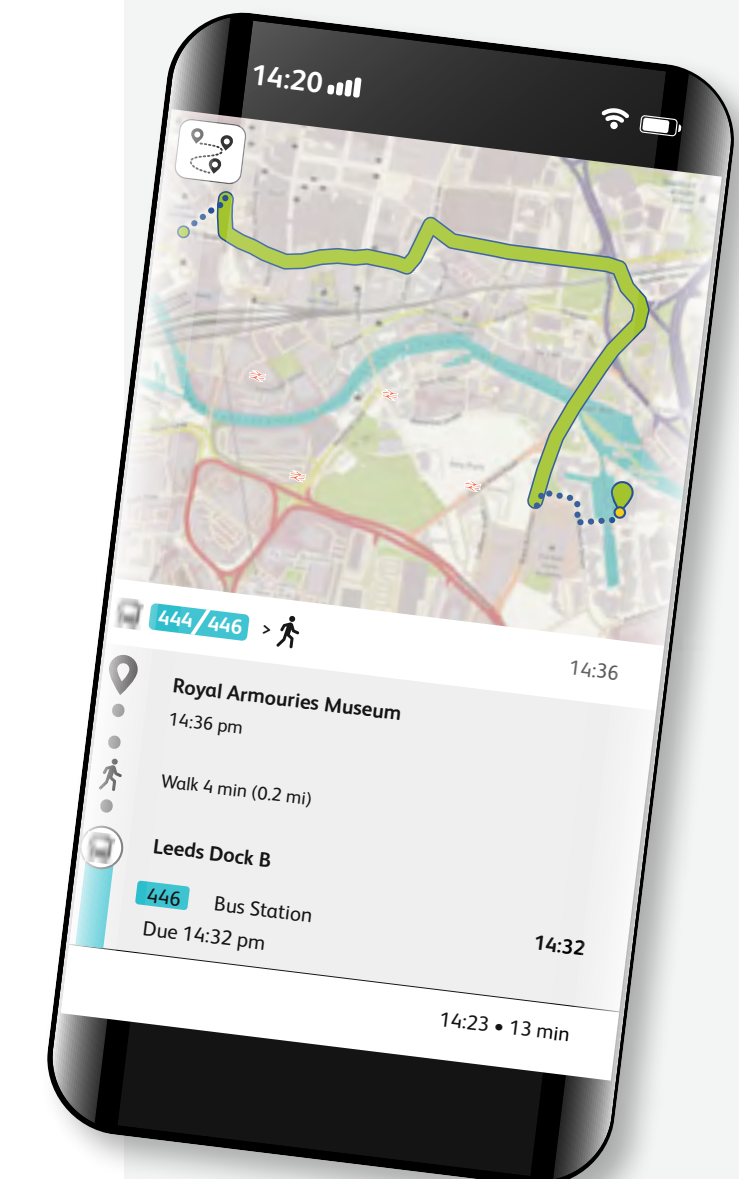
Sometimes known as Passenger Information Displays (PIDs) these are digital signs that are typically positioned at major bus stops and interchanges.

Journey planner apps

Provided on smart phones by local and regional authorities, search engines, Traveline and bus operators as well as others.

Other sources

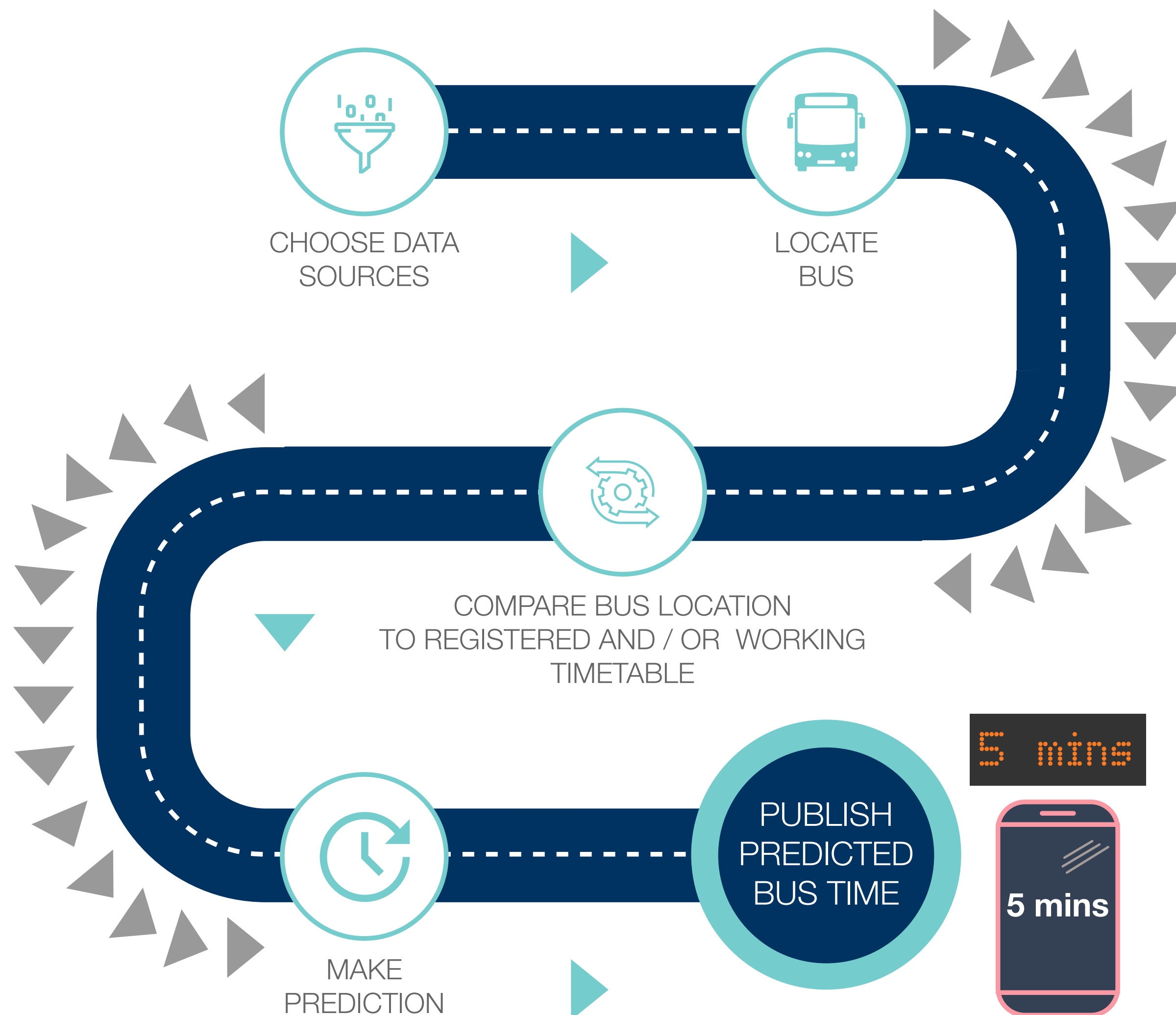
- **Websites** – provided by journey planner organisations;
- **Text messages** – often triggered by scanning QR codes at bus stops;
- **Paper timetables** – at stops and interchanges;
- **Asking others** – especially in rural areas with community transport





RTI Key Concepts:

3. Making a good RTI prediction has multiple dependencies



Making good predictions involves the RTI system knowing:

- Where the bus is right now
- What bus it is (matching it to the right timetable)
- When it is expected to reach the next stop
- If there is any 'disruption' (diversions and cancellations) and 'curtailment' (bus does not complete route) data available to the RTI prediction engine.

The time shown to customers depends on:

- The data source;
- How well that data has been checked;
- Whether it is a predicted time (usually shown as a countdown) or a scheduled time (usually shown as a specific clock time). Many people do not know about this subtle distinction in the way that predicted and scheduled times are displayed. This causes confusion and leads to bus customers trusting RTI less.

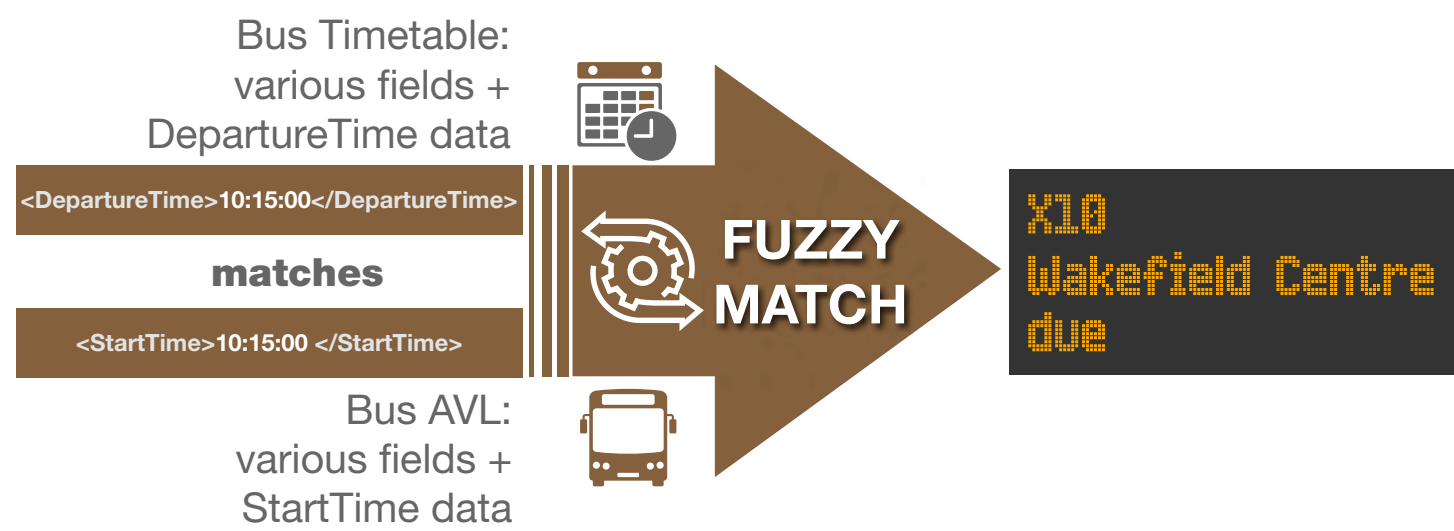


RTI Key Concepts:

4. Data matching

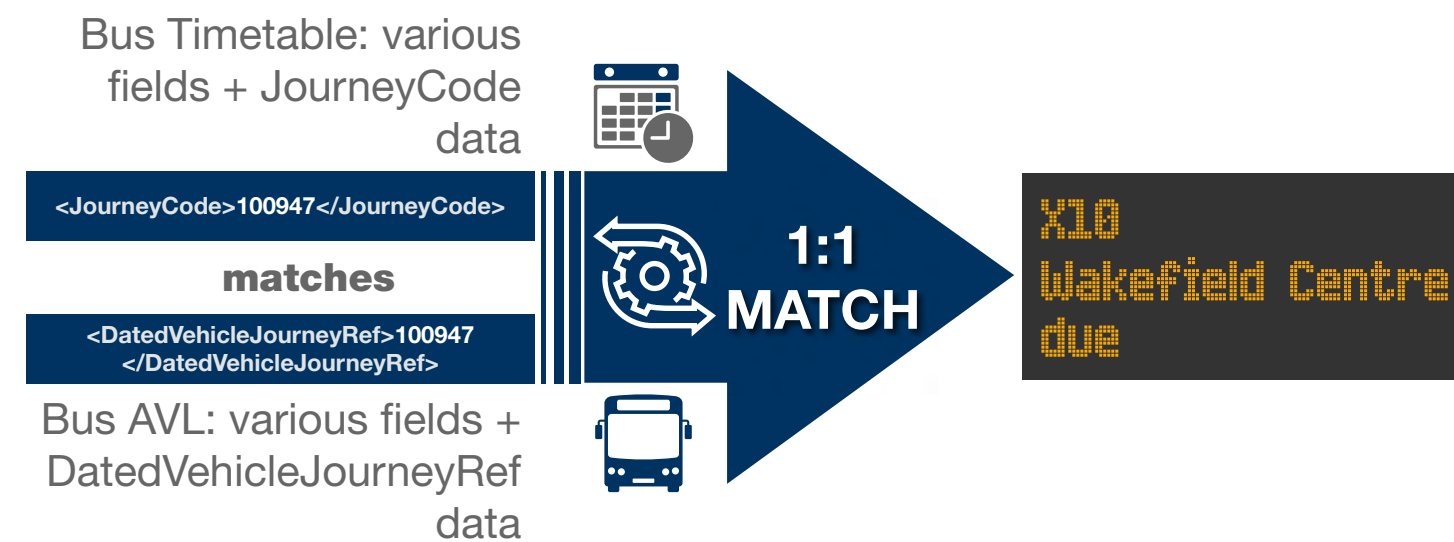
Predictions are made by matching information across different data sources. These sources have to be consistent across multiple systems to achieve a high quality RTI prediction rate for users. Prediction matches methods range from least to most effective:

Fuzzy Match (least accurate):



- No consistent data fields;
- Results can be hit-or-miss;
- Each prediction system uses its own matching rules.

Key Field Match (moderately accurate):



- Uses Shared ID fields in the bus schedule and bus tracking data;
- Helps accuracy but still limited;
- Does not enable cross-journey predictions.

Block Match (most accurate):



- Uses special codes to track vehicles across different journeys;
- Allows predictions, even when a bus vehicle switches to a new route;
- Requires extra work by operators but gives the best results.

The data languages — known as ‘protocols’ — used to enable communication of RTI

Three protocols are used by a RTI Prediction Engine to communicate:

- **Planned operation** — Running Board and timetables: use TransXChange (TxC);
- **Bus location** — via an Automatic Vehicle Location (AVL) feed: uses the Serial Interface for Real Time — Vehicle Monitoring (SIRI-VM) protocol;
- **Stop location** and attributes uses the National Public Transport Access Nodes (NaPTAN) protocol.



RTI Key Concepts:

5. Cross-journey predictions



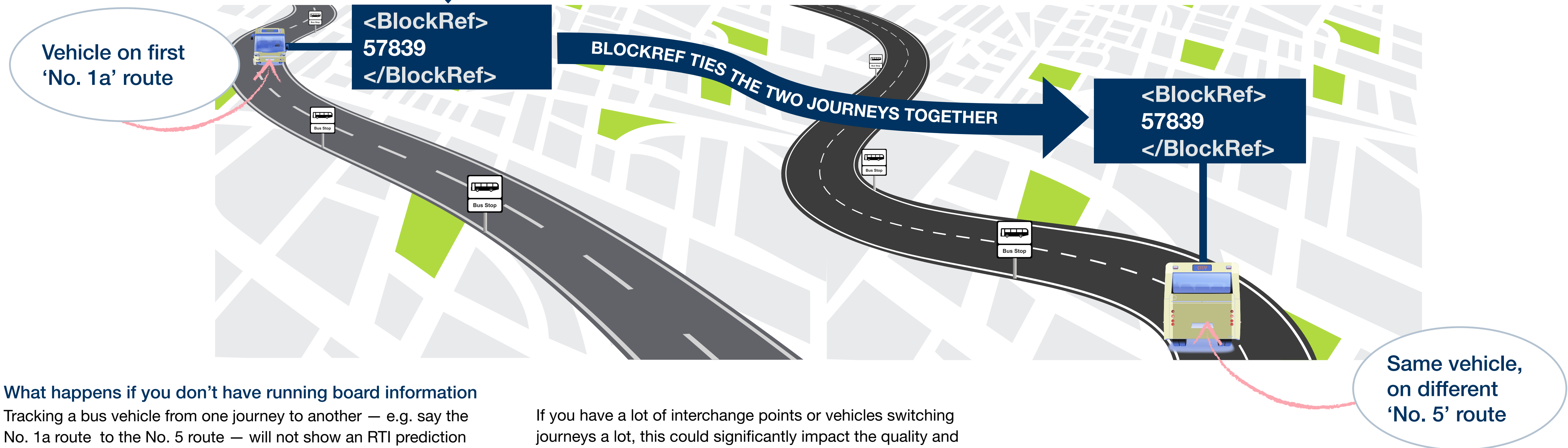
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What are cross-journey predictions?

These track when a bus finishes one route and starts another—important for:

- Managing driver shifts;
- Making better use of buses.

To do this well, operators must use the same ID in both their operational timetables and live tracked data. Without both these IDs present and up-to-date, the system cannot predict the new journey until **after** it has commenced. This leads to gaps in the information shown to customers.



What happens if you don't have running board information

Tracking a bus vehicle from one journey to another — e.g. say the No. 1a route to the No. 5 route — will not show an RTI prediction for the first few stops of the new journey.

If you have a lot of interchange points or vehicles switching journeys a lot, this could significantly impact the quality and quantity of RTI that customers see.

RTI Key Concepts: 6. Good RTI predictions rely on good quality data

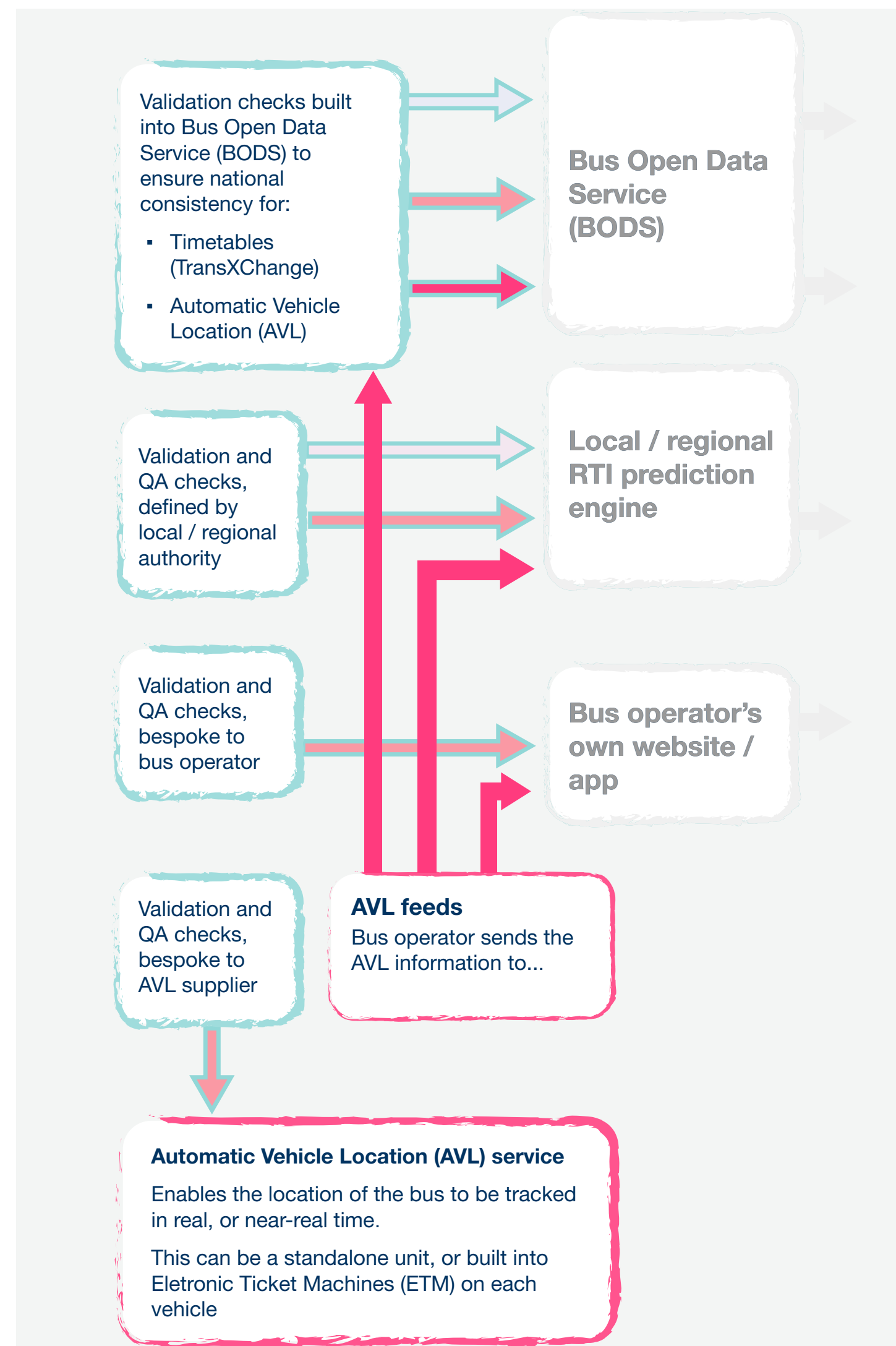
Successful real time predictions will only be as good as the quality of the data that they rely upon. This means:

- Checking and cleaning the data, which takes time and effort — authorities or their software suppliers typically do this work;
- Software to support validation is scarce;
- Some data is not complete or accurate.

When third-party apps use these data, it becomes even more important that the data are reliable because the knock-on effect can be widespread.

Common data quality challenges

- Operators need to provide updates at different frequencies to different systems
- Systems have different validation methods
- Local and Regional Authorities need to consolidate data from different operators in order to create an Authority-wide view that conforms to a common data quality model for the prediction engine they use
- Public and school holiday timetables tend to add to complexity and place further stress on the demand for reliable data.



Ensuring high data quality requires validation

Typical validation steps require

- Setting clear rules for what “good” data looks like;
- Using tools to check that incoming data meets these rules.

This requires resources

- Sometimes not available;
- Authorities with enough staff can help improve data quality — some have teams dedicated to this, such as West Yorkshire;
- Sometimes a team of three or four dedicated specialists do this full-time — e.g. at some of the Regional Authorities.

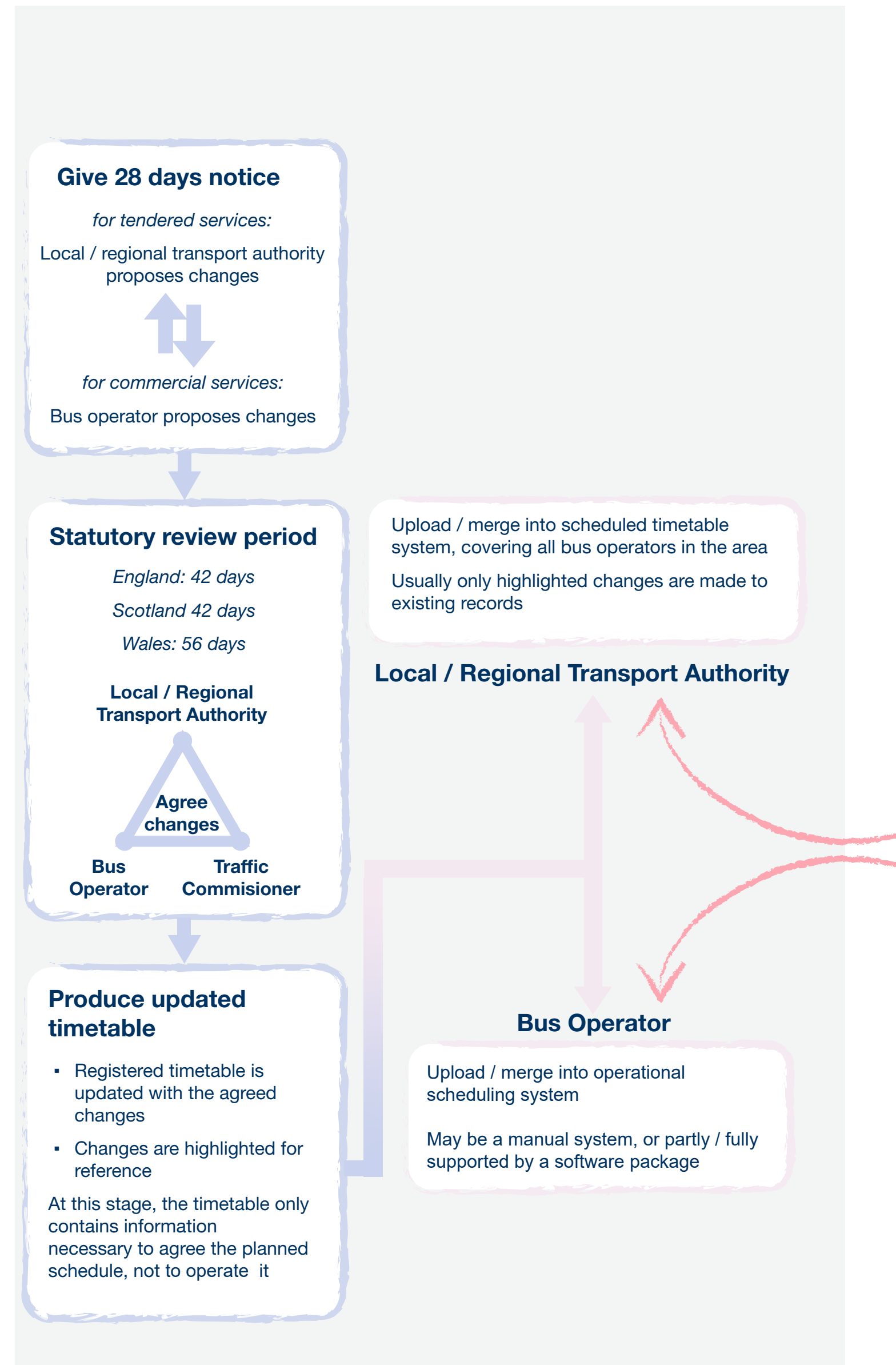


RTI Key Concepts:

7. Timetable matching

Timetable matching is challenging because two sources of timetable are used by different systems in different contexts

Keeping them in sync requires shared data fields. Without this, things like journey planners and real-time signs might not line up, which is confusing for bus customers.



As shown in the diagram opposite, this comes about because after a bus operator's proposed timetable is approved for registration further augmentation and adjustment of the registered timetable is undertaken separately by a Local or Regional Authority and the bus operator.

1. Local or Regional Authority consolidated timetable

- Based on the official registered version;
- Combines all services in a defined geographical area;
- Adds extra local info;
- Sent to apps, prediction engines and printed publicity.

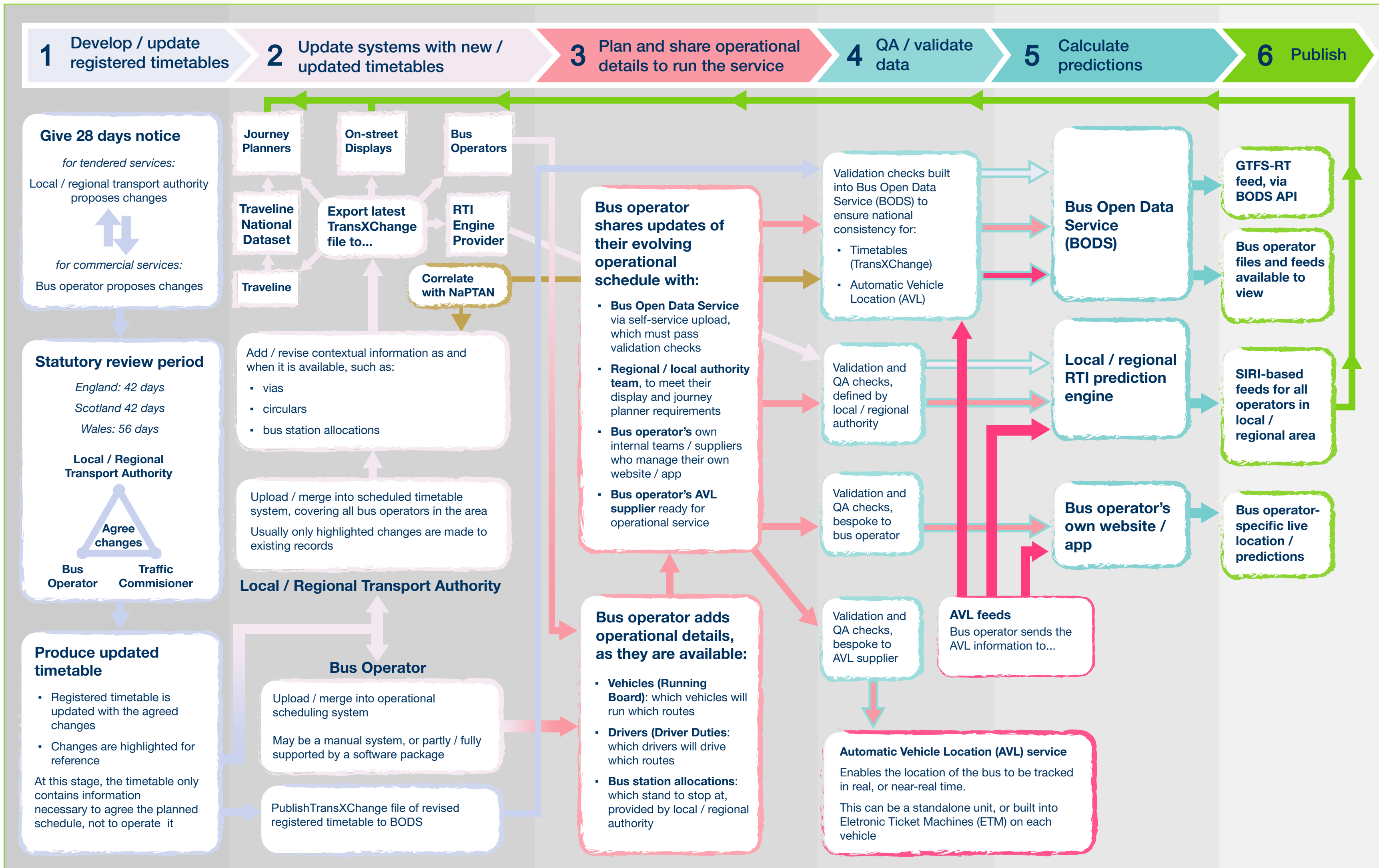
2. Bus operators' operational timetable

- Also based on the official registered version;
- Includes driver and vehicle details;
- Not always compatible with national stop names;
- Sent to apps, prediction engines and BODS —though often stripped of vital BLOCK information when sent to BODS;
- Used to feed live tracking systems.



RTI Key Concepts:

8. Whole system workflows are complex



A

Senior manager guidance:
Senior manager role

RTI Role		Technology
Directing		Office automation
Dealing with customer issues escalated to her		Statistical programmes
Seeking resolution		Publishing programmes
Skills	Channels	Browsers
Policy	Social media (various)	Chrome
Leadership	WhatsApp	
Masters Degree in Psychology	Web	



Cleo Haines

Regional Authority Director

“Inaccurate digital bus signs attract lots of adverse media coverage and customer complaints. I want to understand how I can help my team to do their part to improve accuracy”

Goals

As part of the Senior Management Team, we are the public face of the authority and set strategic priorities for buses to help ensure they are the affordable, accessible public transport option that get people to work, education and leisure. They are key to our transport strategy, and we invest to support operators and improve services.

Motivations

I want to respond to these complaints by delivering improved quality of real time information available on on-street displays in our area. Accuracy of RTI and the ability to know if the bus you are waiting for is due to arrive or has already departed is a top priority. This is a technical topic, and not one I understand. I feel

for customers and want us to solve these problems for them. Our transport teams are doing a great job with the resources they have, but it is difficult to make much headway with improvements.

Frustrations

My team and I identify specific feedback that we want to address, and we agree a plan for improvements with our transport team. But often, when things are investigated other problems are found. This causes delays and workarounds, with no obvious improvements in the eyes of the public. This reduces public trust in choosing to use the bus and their belief in us to meet their needs, which goes against our strategic goals.

RTI troubleshooting for Senior managers

The Key Concepts section of this guidance should assist you in working with your team to understand what might be wrong with the RTI you have asked your team to investigate when an issue is reported to you, or a customer complaint has been made.

You can also use the Key Concept pages to triangulate between your own observations about the accuracy of digital bus time signs and apps and what might be causing a discrepancy or other quality issue.

B

Local & regional authority manager RTI guidance:

Local and regional authority RTI manager role

RTI Role		Technology
Managing a specialist local authority team		SQL Server
Liaising with senior management and bus operators		Various RTI platforms
Responsible for resolving issues		Office automation software e.g. M365
Skills	Channels	Browsers
Negotiation	Various social Media	Microsoft Edge
Degree in History	WhatsApp	Chrome
Management	LinkedIN	



Casey McNeil

Transport Manager

“My team and I are responsible for making sure our RTI digital signage and local and national app providers use reliable information. It’s complex and requires a lot of collaborative work with our bus operators.”

Goals

My team produce a scheduled timetable dataset for all bus services and operators in our area This is updated regularly to reflect service changes agreed with bus operators. This dataset is the source of all scheduled times shown on our on-street displays, in printed timetables, and through Traveline and other journey-planning app providers. We add local information to it, like bus station allocations and local names for circular routes.

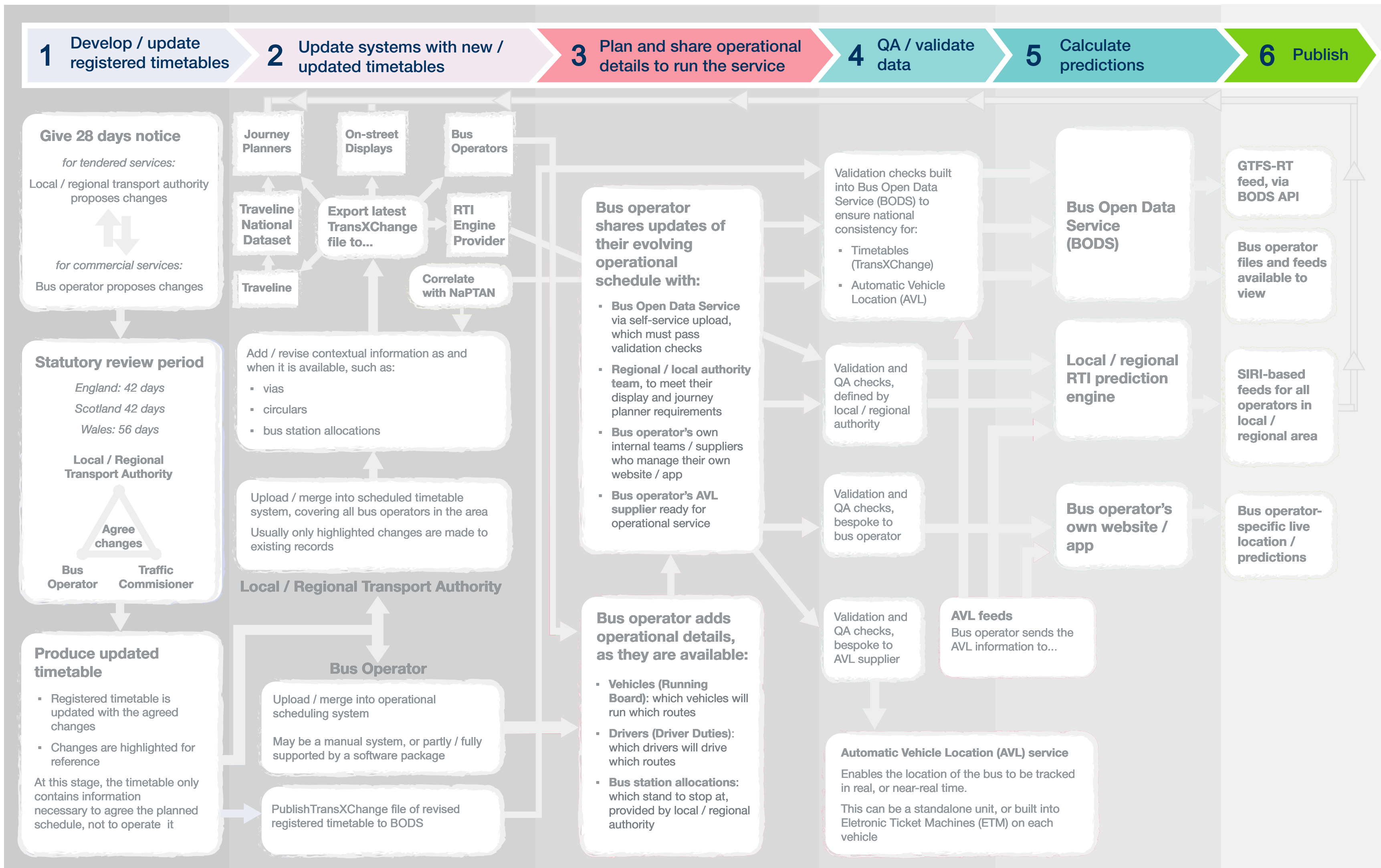
Motivations

I love doing what we do because our work improves people’s journeys. We provide high quality timetable information for our local area that isn’t available from any other source. We help all our bus operators supply the best quality data to us that they can. We know this will look different for smaller local operators compared to the large national ones, and we flex to accommodate that.

Frustrations

I want to give a good service but there is only so much within our immediate control that we can action. We don’t always have full visibility of RTI performance across the network, so we rely on customer feedback. It’s a constant challenge to translate the potential benefits of the technology with the actual benefits to customers on the street.

B Local & regional authority manager guidance: RTI system steps for Authority managers



Click on each button to view a step. Double left arrows return to the blank diagram. Double right arrows go to the last Step.

C

Bus operator RTI guidance:
Bus operator RTI role

RTI role		Technology
Scheduling		Electronic Ticket Machine configuration
Government, local and regional authority liaison		Scheduling and operational platforms
Bus operations mangement		Office automation software
Skills	Channels	Browsers
ITIL	FaceBook	Chrome
Management	Various social Media	Opera
HND in Engineering	WhatsApp	



Eddie Cortez

Senior Scheduler

“The data and software that run bus operations is surprisingly complex and getting more so. Keeping on top of it all in a challenging commercial environment is the cornerstone of my job.”

Goals

To get drivers, buses and services co-ordinated as safely and efficiently as possible.

Background

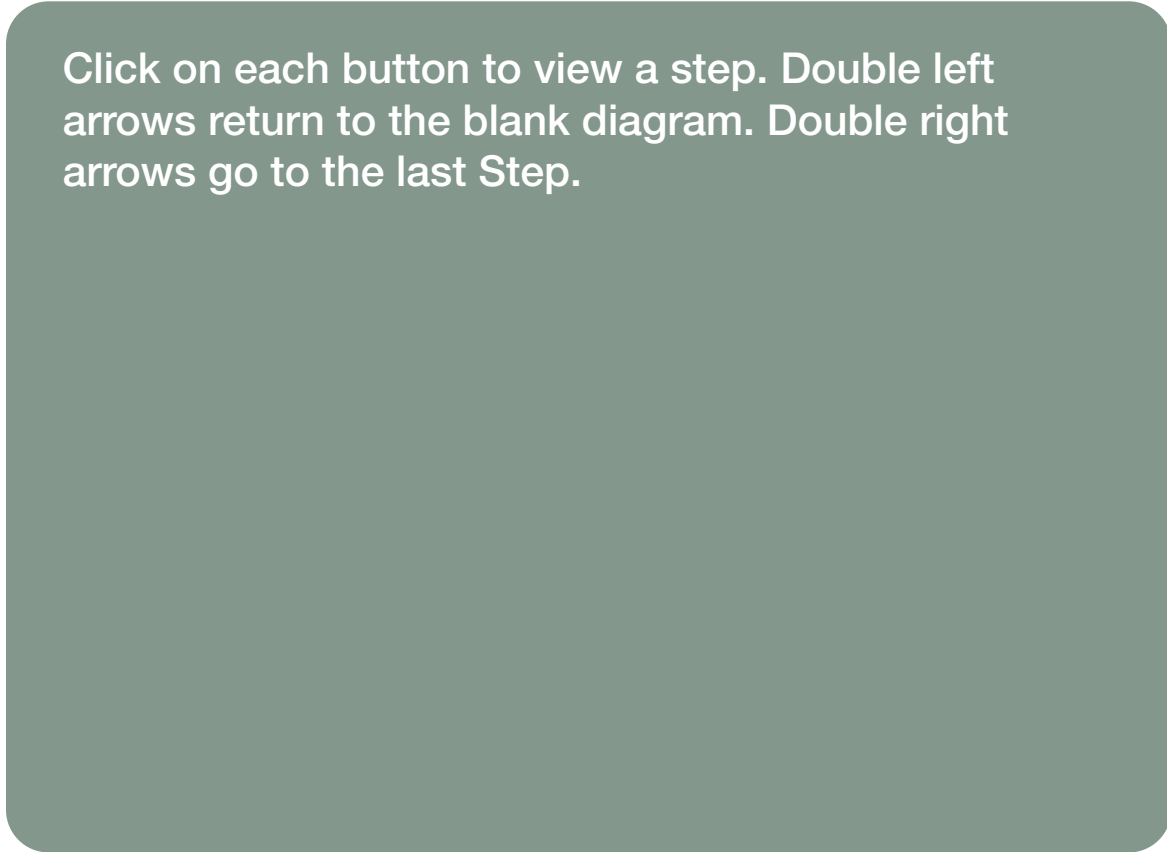
I started my career working for my family’s bus company and learnt the ropes from my Dad. We were a small outfit, and didn’t need the software packages I use now.

Motivations

I get satisfaction from creating workable plans and juggling competing priorities to achieve it. My background helps keep me grounded in the realities, but the large bus company I work for now could never operate without the support of operational software. I enjoy training new members of my team on the job requirements and how to achieve it using the software. It’s unusual for someone to have a full understanding of all aspects of the scheduling job (scheduled timetables, working with drivers and fleet teams to plan operations, commercial reporting, and the technical data side of things).

Frustrations

Whilst it’s a good thing to get our data out there to help customers make journeys more easily, it makes our job more complex. We’re not data people, and so we’ve had to learn ‘data speak’ as we go along in order to answer questions about data fields, formats and processes. It’s opened my eyes to how what we do day-to-day to make our services run affects the quality and availability of the RTI predictions on-street and in apps. It makes finding the right people for the job, and what we can afford to pay, more challenging.



D

Bus operator RTI software supplier guidance:
Bus operator RTI software supplier role

RTI role		Technology
Product mangement		CRM software
Software development		Various RTI platforms
Project management		Office automation software
Customer relationship management		
Skills	Channels	Browsers
Project management	FaceBook	Chrome
Product management	Various social Media	Opera
BA in English Literature	WhatsApp	



Stephanie Townsend

Bus Operations Software
Account Manager

“Our customers operate on very tight margins. It’s my job to ensure that our software makes their work easier. I don’t know all the ins and outs of how the whole RTI thing works but I’m keen to learn.”

Goals

To adapt and innovate our product line, and help our customers spend less time meet the increasing need for data provision to support RTI.

Background

I work for one of the established suppliers in this field and have been in my role for 15 years. Our customers value our capability and expertise, but the changes in recent years have challenged our ability to keep up with changing needs.

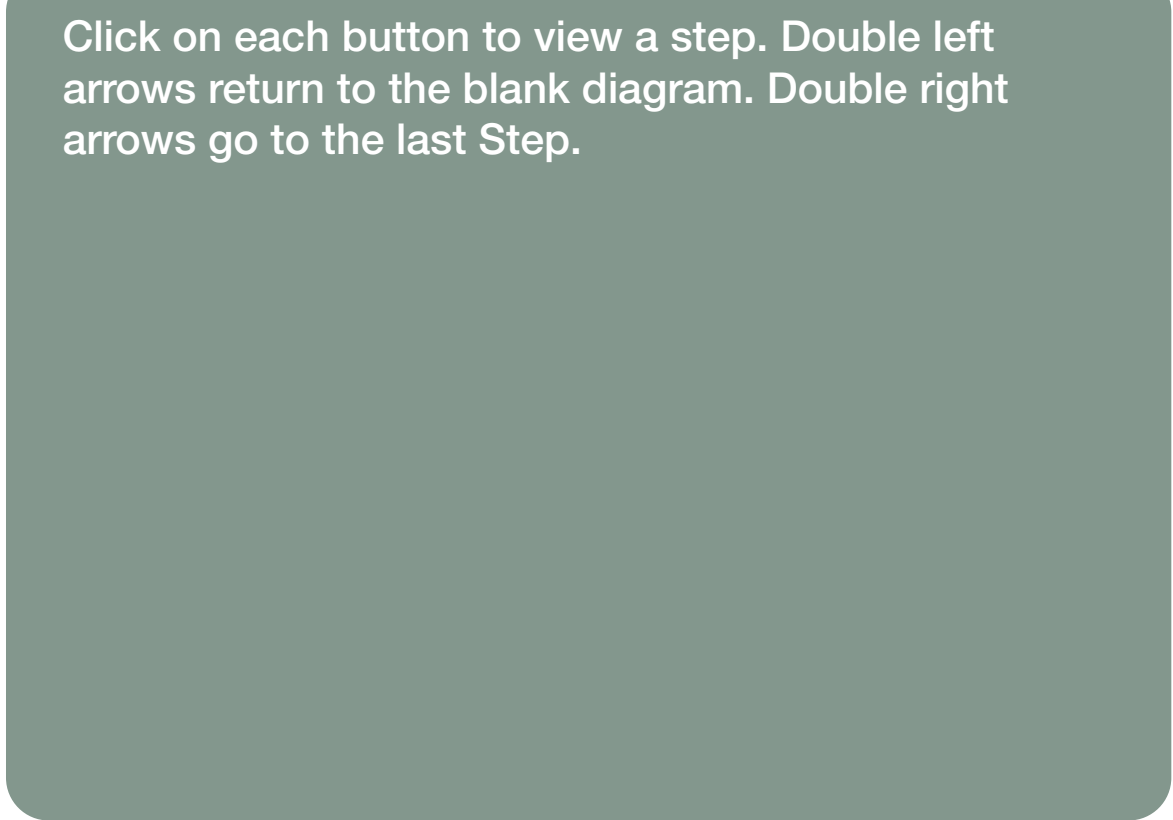
Motivations

We keep our ear to the ground through the relationships we’ve built with our customers, and we are actively involved in industry working groups. Our core offering has been for bus customers, and that might not change, but there is a lot of disruption with new entrants attempting to get a foothold in the market. The way things used to work probably won’t be how they worked in the past. That keeps us on our toes, and we need to keep ahead of the curve.

Frustrations

The complexities of getting accurate RTI information out to customers is I think in part due to us having to stitch together traditional ways of doing things. Our customers end up having to do a lot more manual interventions to get data to the right places, and it’s impacting their ability to do the day job. We want to help overcome some of those hurdles, but there are limits to what we can engineer in the timeframe to meet these needs, and still offer a competitive product.

D



E

RTI software supplier guidance:
RTI software supplier role

RTI Roles		Technology
Customer and customer product mangement		Microsoft Project
Software development		Various RTI platforms
Project management		Office automation software e.g. M365
Skills	Channels	Browsers
Product Management	Various social Media	Chrome
MSc in Maths	WhatsApp	Microsoft Edge
Agile Project Management	LinkedIN	



Josie Peterson

Product Manager

“I’m responsible for growing more mature products and services from the start-up offerings. I have experience in transport but not real time systems. I’m looking for ways to streamline what we do and design off-the-shelf products that our customers need. The client base seems to be split between bus operators and public sector agencies.”

Goals

Our products have been built in response to specific needs of customers. They are managed by different teams, and we have an opportunity to connect these together in a more streamlined suite of services.

Background

My previous experience in transport is useful in this role because it help[s] me to understand the system from the journey maker’s perspective.

Motivations

We want to make the most of our expertise and serve a broader customer base. We began by building timetabling systems for bus operators, but we think we can break into the public sector supplier market and shake it up a bit. There are a few core players in that market, and we think our experience with bus operators is useful. There are differences though, which we are having to overcome. Whilst bus operators are responsible for managing the operation of their services, and adding RTI to their own websites, the priority for public sector agencies is to compile scheduled information together from multiple operators, and to validate and check the data quality of operational data supplied for RTI.

Frustrations

Each specialist team works on their own products and doesn’t understand how their work relates or connects into the work of other teams. I’m having to learn a bit about each of them, to try and help bridge this gap. It’s complicated, and RTI in particular is a challenge to understand and then explain.

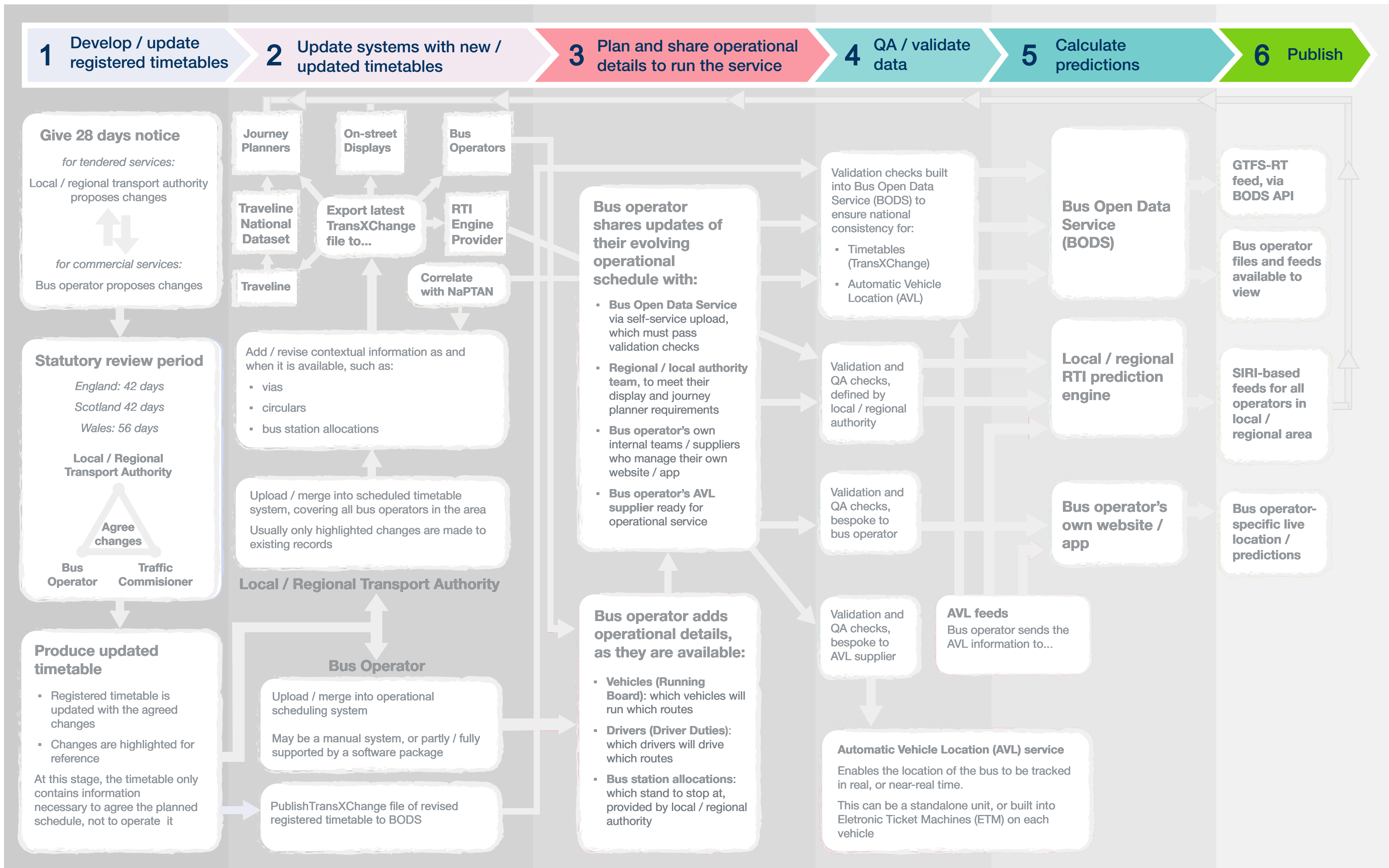
RTI system steps for Authority RTI specialists

RTI system steps for bus operator website specialists

RTI system steps for BODS specialists

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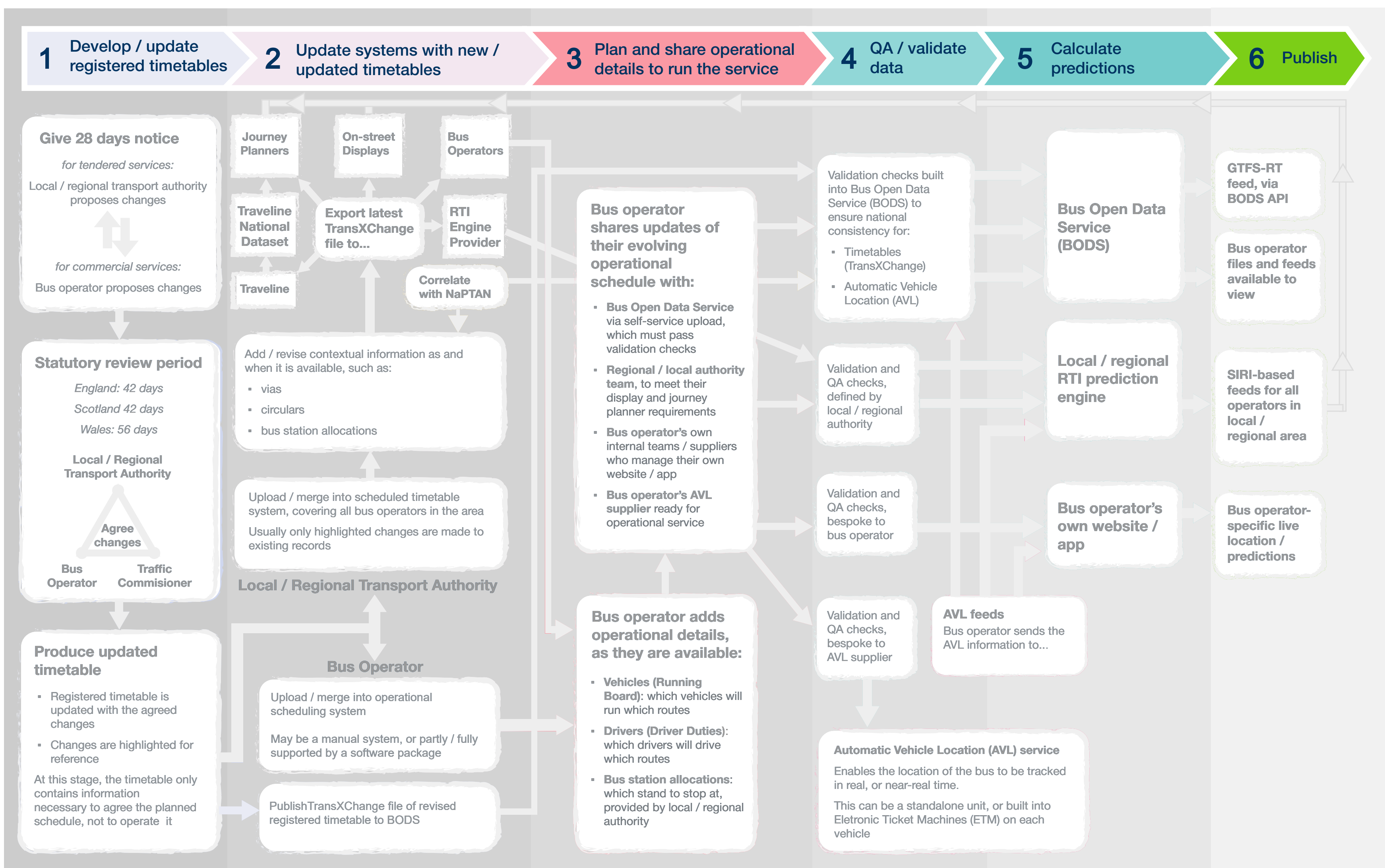
RTI software supplier guidance: RTI system steps for Authority RTI specialists



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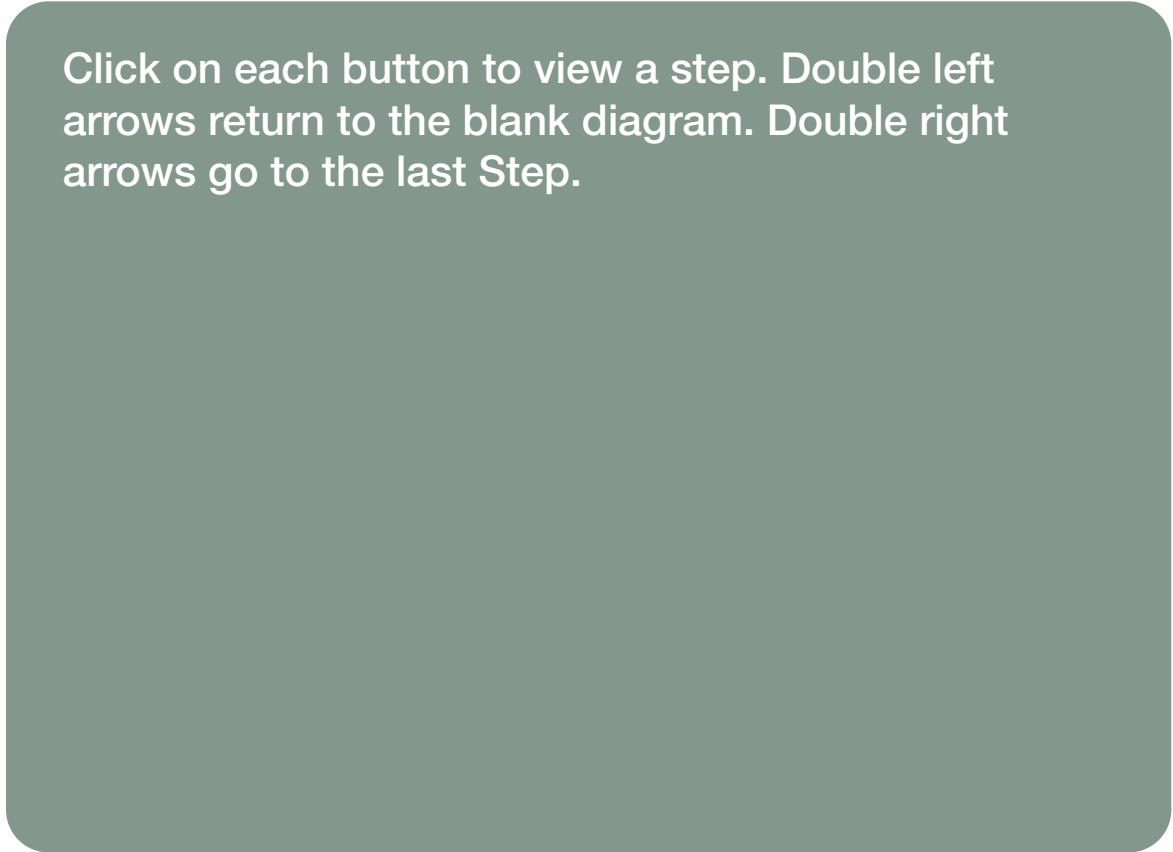
E

RTI software supplier guidance: RTI system steps for bus operator website specialists



Click on each button to view a step. Double left arrows return to the blank diagram. Double right arrows go to the last Step.

E





Glossary: Abbreviations and definitions

AVL

Automatic Vehicle Location is a means for automatically determining and transmitting the geographic location of a vehicle

BLOCK

Block is used as a unique identifier for a sequence of journeys that a vehicle makes during a day. It is a way to match real-time vehicle data with static (scheduled) information.

BlockRef

A unique identifier used in SIRI which can be matched to the same identifier to data in an operational timetable or Running Board.

BlockNumber

A unique identifier used in TXC which can be matched to the same identifier in SIRI-VM data.

BODS

Bus Open Data Service

CMS

Content Management System

DfT

Department for Transport

DRT

Demand Responsive Transport

EBSR

Electronic Bus Service Registration

ETM

Electronic Ticket Machine

GIS

Geographic Information System

GNSS

Global Navigation Satellite System

GPS

Global Positioning System

GSM

Global System for Mobile Communications

ITS

Intelligent Transport System

LCD

Liquid-Crystal Display

LED

Light Emitting Diode

NaPTAN

National Public Transport Access Nodes

NeTEx

Network Timetable Exchange

NOC

National Operator Code

NPTG

National Public Transport Gazetteer. Identifies all transport stops.

OTC

Office for the Traffic Commissioner

PIDS

Passenger Information Display Screen

PMR

Private Mobile Radio

PTI

Public Transport Information

PTIC

Passenger Transport Information Coordination

QA

Quality Assurance

QR Code

Quick Response Code

RTI

Real Time Information

RTIG

Real Time Information Group

RTPI

Real Time Passenger Information

SIRI

Service Interface Real-Time Information. Normally a specific SIRI service type will be specified: SM Service Monitoring

- SX Situation Exchange
- PT Production Timetable
- ET Estimated Timetable
- VM Vehicle Monitoring
- GM General Message

TFT

Thin-Film-Transistor liquid-crystal display

TIL

Traveline Information Limited

TNDS

Traveline National Data Set

TxC and TransXChange

TransXChange is the UK nationwide standard for exchanging bus schedules and related data. It is used for: the electronic registration of bus routes; the Traffic Area Network; the exchange of bus routes with other computer systems such as journey planners and vehicle real-time tracking systems

XML

Extensible Markup Language

XSD

XML Schema Document