

January 2023

Dear Colleague

Multi-Modal and Multi-Operator Barcode Ticketing**Why barcodes?**

Barcodes offer a simple, low-cost method of encoding ticket information using well established core technology, supporting digital ticket validation. Already widely implemented in both the rail and bus industries, they provide a secure solution when implemented within mobile phone Apps.

However, the rail industry excepted, currently each supplier has their own barcode standard, and none of them interoperate with each other. This means that users must have different phone Apps for each operator whose services they use.

If the interoperability issues can be resolved through the use of a common standard, then barcodes will form the basis for multi-modal/operator ticketing and as a stepping stone in the development of future MaaS schemes.

STAG's Task Force 2 (a volunteer working group) has developed an outline proposal to address the interoperability issue, which is attached to this letter. If you want to learn more, provide feedback, or get involved in this initiative, please use the enquiry form on <https://www.stag.group/>.

Management Summary

A common barcode standard is proposed, allowing multi-modal / multi-operator ticketing using mobile phones.

It is not proposed that use of the common barcode standard would be compulsory – Operators could continue to use their own barcode standard in parallel with the common approach. It is also not proposed that barcodes supplant the use of ITSO smartcards and contactless bank cards, but simply become part of the ticketing mix.

It is proposed to adopt the barcode standard developed by the rail industry. This is open, fully documented and proven, and already implemented across much of the whole UK rail network. A new ticket variant will be developed within the scope of the rail specifications, tailored to meet the needs of non-rail transport modes including appropriate security arrangements.

To support use of the common barcode a settlement system will be required, as will management and governance systems to ensure consistent and therefore interoperable implementation.

The purpose of this letter is to inform a wider audience of the activities relating to barcodes and also to solicit your comments, suggestions and most importantly your inclination to support this work and its potential deployment.

About STAG

The Smart Transport Advisory Group (STAG) is a grouping of interested parties including operators, suppliers, and consultants. Membership is open to all. It explores issues of interest to members and has set up a small number of task forces to explore specific areas. Currently these are Account Based Ticketing, Contactless Bank Cards, and Multi-Modal Interoperable Barcode-Based Ticketing.

More details can be found at <https://www.stag.group/>

If you wish to learn more or get involved, please use the enquiry form on the STAG website.

Best Regards

STAG

STAG TF2 – Multimodal Barcode Ticketing

An Overview

Peter Johnson December 2022

Introduction

This paper is intended as a short overview of multi-modal barcode ticketing, using mobile phones, based on the Rail Development Group (RDG) specifications.

This paper summarises the ongoing work of STAG's Task Force 2 (TF2).

Rationale for adopting the RDG Specifications

The rationale for adopting the RDG Specification is attached in Annex 1Annex 1Annex 1Annex 1Annex 1Annex 1Annex 1, which is based on TF2's discussions to date.

Use of RDG's Specification

This specification is used across the rail industry for barcode ticketing. Extending it to other modes such as bus, light rail, ferry and possibly transport hire services (for example, cycle, scooter and car hire) is proposed where multi-modal barcode ticketing is required.

It is not intended that the non-rail modes be required to convert to the RDG specification for all their barcode ticketing. Many systems have already implemented barcode ticketing using other specifications and there is no reason why this should not continue. However, operators wishing to take advantage of multi-modal/operator tickets using the RDG specification would have to implement the RDG specifications over and above their existing system.

Retail

Systems for retailing multi-modal barcodes are essential. Currently retail systems tend to offer only a single mode of transport, with a few limited exceptions such as PlusBus. If the benefits of multi-modal barcodes are to be achieved retail systems must be developed to support these.

Any retail system must have knowledge of all the ticket types and the associated fares, which are frequently journey / passenger class dependant. Retailing in a multi-modal environment inevitably increases complexity significantly.

Since large and possibly multiple fare databases will be required in a multi-modal environment, it seems unlikely that retailing will be established on mobile systems, such as on-bus ETMs. The only exception to this would be for systems with a permanent internet connection, which could connect to the multi-modal fares database.

On-line retail will be simpler to achieve, and is more likely to be implemented, at least initially.

Because the retail systems are creating barcodes, then full RDG accreditation will be required covering just the barcode related elements of the specifications. Note that RDG accreditation only applies to those parts of the RDG specification used, i.e., in this case just the barcode elements.

The Barcode

The RDG barcode consists of a header and an encrypted data payload. Multiple payload types are supported with the type used in any barcode identified in the header. This format allows the creation of new payload type specifications if these are required.

Rail use a separate barcode for each journey (which may be multi-leg). Note that a single code is used to define a season ticket. This practice could continue with separate codes on non-rail modes, or for non-rail modes a return ticket payload could be defined.

The barcode can be fulfilled as a paper ticket, or using a mobile phone app. Using an app is much preferred from a security point of view but does risk excluding a proportion of potential travellers. However, conventional ticket media would accommodate those people.

Validation

Customer facing terminals will need to be updated in accordance with the RDG barcode specifications, so that they can validate codes.

RDG have confirmed that accreditation of validators (e.g. gates) is not currently required. However, there is some pressure for accreditation to be introduced.

It should also be noted that where validation data is used for settlement purposes, then some form of equipment validation would be very useful

Ticket Types

So as to provide maximum flexibility for operators, and cost effectiveness for passengers, the system should be capable of supporting all operators ticket types. This flexibility will inevitably increase the complexity of retail and settlement systems.

Limiting the range to ticket types to those easily implemented also reduces the benefits of multi-modal ticket implementation. For example, the current PlusBus implementation retails an area-based bus pass. This is inevitably more expensive than purchasing two singles or a return ticket on bus, and therefore savvy travellers do not use it. Take up is therefore limited by the simplicity of the ticket sold.

Account Based Ticketing (ABT) and Mobility as a Service (MaaS)

As an alternative to conventional ticket types encoded within the barcode, the barcode could be used as a "token"¹ with an ABT/MaaS scheme. This approach

¹ Account Based Ticketing (ABT) schemes involve storage of customer and ticket/payment/e-purse details in a back office. The customer carries a "Token" which identifies them to the system and allows travel. The fare for that travel is then settled within the back office.

very much simplifies the barcode, it's creation and the mobile phone App which stores it, moving the complexity into a back office. One advantage of storing the token in an App is that should the customer prove to be not credit worthy, then it is a simple matter for the App, and therefore the token, to be disabled via the phone's internet connection.

Settlement

Accurate and reliable settlement is critical to involving various operators in multi-modal ticketing.

Currently RDG has its own settlement system, and presumably this will continue with the establishment of Great British Railways (GBR) for the settlement of funds between GBR and the devolved railways. However, it's not certain that RDG's settlement system has the capacity to handle transactions from the multitude of non-rail operators.

PlusBus settlement is based on settlement between RDG and a small number of Lead Operators, one in each region covered by the scheme. The lead operator is then responsible for settlement with the other operators in their area. Whilst each lead operator only deals with (presumably) a single ticket at a single fare, and numbers are low, this approach works. However, extending the scheme to multiple ticket types with (hopefully) much larger transaction volumes, would impose a significant burden on the lead operator.

The PlusBus approach does suggest a possible solution, which is that one or more third parties set up a settlement system. This settlement system would communicate with the RDG system and provide settlement services to a number of non-rail operators.

The settlement system operator would charge a fee for its services, which would need to be taken into account when developing business cases. Clearly the more this service is used the lower the fee.

Because of the capital costs involved in setting up the system, it is likely that the number of organisations providing this service would be very limited. A business case for setting up such a service would rely heavily on anticipated take up levels and may therefore be difficult to establish.

There are various ways in which this difficulty could be overcome, including by reducing the initial capital cost. One approach would be to develop a small scale, but scalable, solution, meeting the needs of a limited number of operators. This system could then be expanded as usage increases. Alternatively, a suitable system may already exist elsewhere in the world which could be adapted for use in the UK, or a system designed for concessionary pass reimbursement could possibly be adapted.

Regarding funding, public seed funding is an option, or a group of operators could contribute to development. A combination of the two is a likely scenario.

Communications and Messaging

The various system elements will need to communicate with each, for example:

- Validators and Retail systems to a back office;
- Back offices to settlement systems;
- Non-rail settlement system(s) to the RDG settlement system.

It is probable that communications with RDG systems will have to conform to the RDG specifications for messaging and communications.

However other communications links need not necessarily conform to the RDG specifications, provided all the required data is communicated in a secure manner. ITSO is a precedent for this approach, where (for example) communications between ETMs and the local back office are not required to conform to the ITSO specifications. There may need to be some form of certification activity to ensure that the overall system integrity and security is not compromised.

Security

RDG have specified a method for encrypting ticket data, and for distribution of security keys. This prevents fraudsters from creating their own tickets, providing of course that they don't manage to obtain the security keys. It is likely that all implementations will be required to comply with this specification.

With barcodes there is a clear risk that dishonest people will simply copy the barcode to create multiple tickets. This is a major risk with printed paper tickets, and the rail industry is working on solutions for this. These solutions involve barcodes which are unique to each individual ticket, together with an on-line database² which records when each ticket has been validated or cancelled. Attempted reuse of the ticket is prevented when validation equipment checks the on-line database.

Use of a mobile phone app offers more opportunities to prevent copying. Systems have been developed which change the barcode periodically, meaning that a static copy of the code will not be valid after the dynamic version in the app has been changed. It should be noted that using a mobile phone app does discriminate against a proportion of the population, because of "tech phobia", fraud concerns, and concerns over the cost of the device and of a mobile internet connection, although this proportion is likely to reduce over time.

The bus industry, who it is anticipated would be a major user of any interoperable barcode scheme, are very risk adverse. Buses also operate in an environment where an internet connection cannot be guaranteed. It is therefore considered unlikely that the current security measures developed to suit rail's needs would be adequate for the bus environment.

Because bus and other modes will require different ticket parameters from rail, a new variant barcode within the rail specifications will be required. This could include a method by which the barcode is changed periodically when displayed on a phone, i.e. refreshed, which could be every few seconds if that is considered necessary. Ideally this method would operate irrespective of whether the mobile phone had an internet connection at the time of ticket validation.

Governance & Management

RDG already provide governance and management functions for the rail industry. It is not yet clear whether they would be willing and have the capacity to provide these functions for other operators. If RDG are not willing, then a separate organisation will have to take this work on, in which case rail will continue with its own management and governance arrangements solely for rail operators.

² The Electrical and Ticket Validation Data Base (eTVD) maintained by each TOC. These databases are linked so that all TOCs have access to this information.

Please see Annex 2 for more on management and governance.

An element of the work on management will be to explore the commercial aspects of this development. There may be charges for a number of services provided by various parties facilitating multi-operator barcode ticketing. These could include for example: licencing for use of the RDG specifications; a charge for maintenance and provision of the RDG and bus/tram/ferry ticket specifications; settlement fees; management and governance fees. Work will be needed to determine whether all of these potential fees will in fact be charged to operators, and if so, their magnitude.

There may be concerns about the various parties longer term commitment to barcode based interoperable ticketing. For this purpose, a formal Agreement would be desirable, locking in the various parties ongoing commitment to the project. The parties to the agreement could include RDG, transport authorities, non-rail transport operators, and / or passenger transport organisations. The agreement could cover management and governance arrangements, commercial arrangements, use of the specification, security and confidentiality principles, and settlement principles.

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Annex 1, Rationale for adopting the RDG Specifications

Introduction

Whilst considering their objective of “facilitating implementation of barcode based ticketing interoperable between operators and modes”, TF2 have considered 3 options:

1. Develop a new specification for everybody in the UK to use; or
2. Adopt an existing specification and work to promote general acceptance; or
3. Develop a method for accommodating all the different approaches taken by suppliers?

Outcome from TF2’s Discussions

Option 1. A new specification:

- It was noted that bus and rail operators in the UK have already implemented barcodes, although to differing specifications;
- It was generally agreed that, whilst a new specification was the initial focus of this group, it is very unlikely that operators would invest in a completely new specification at this stage in view of the wide range of barcode ticketing already deployed;
- Therefore it is proposed that this option should not be considered further.

Option 2. Use of an existing specification:

- A number of specifications are currently in use in the UK, however to the best of the participants knowledge most are proprietary to equipment / system providers;
- Only the RDG specification appears to be formally specified with governance and accreditation arrangements. This specification is currently in use by all the UK rail operators (so is effectively already being used in a multi-operator environment);
- The RDG specification has recently been implemented by one supplier of Bus ticketing equipment, enabling its use for PlusBus tickets;
- RDG have advised the TF that Rail are open to implementing bus tickets using their barcode specification, and are currently working with Ticketer to implement PlusBus on rail compatible barcodes. As previously noted this arrangement has been implemented on GWR rail services and First Bus services;
- It should be noted that non-rail operators will not be forced to change barcode specifications, but can continue with their existing solutions, using the RDG specification just for interoperable tickets;
- The group therefore agreed to recommend the use of the RDG specification as the basis for going forward, subject to:
 - o RDG agreement;
 - o The views of the various Bus ticketing equipment suppliers, including for example Flowbird, Init, Ticketer, Transmach & VIX;

Option 3. Accommodating multiple specifications within a common framework:

- In theory this is an ideal approach because it could minimise operator investment;
- It was noted that a similar approach has been taken in other circumstances, for example the types A, B & C specifications for ISO/IEC14443 NFC contactless smartcards;
- However, the group could not see a way in which this approach could be achieved without multiple barcode standards being required. i.e. the user would have to ensure that the correct barcode was displayed at the right time, which will inevitably result in confused customers;
- Whilst in theory the retail system can create the barcode type appropriate to the operator used for each journey leg, this becomes impractical where a journey leg could be undertaken with a choice of operators who use different barcode standards;
- There was also concern that it would be difficult to avoid abuse and fraud:
 - o Security key distribution is a particular concern, both in terms of logistics and maintaining key secrecy;
 - o Verification processes would be required for each system.
 - o There is concern that a lot of bespoke single operator barcode solutions are somewhat basic and not scalable. Even if they have security controls, they will be reluctant to share them as they could compromise their simple propositions;
- Co-ordination, management and governance would be complex. How would this be provided and how would it be funded?
- In view of these difficulties it is proposed that this option should not be considered further.

Annex 2: Governance and Management

Rationale – why do we want management and governance?:

- Ensure fair and equitable treatment of all parties, i.e. no one party or sector dominates;
- Ensure a consistent implementation avoiding differences between systems which cause interoperability problems;
- Facilitate resolution of disputes between parties;

Principles:

- Independent;
- All sectors adequately represented so that no one sector is dominant;
- Authoritative;
- Respects the rights and views of participants, working for consensus rather than domination.

Options:

- One existing operator or sector provides management and governance (fails the independence test);
- A “club” of operators elect a management committee and a manager
- A small & efficient independent manager.

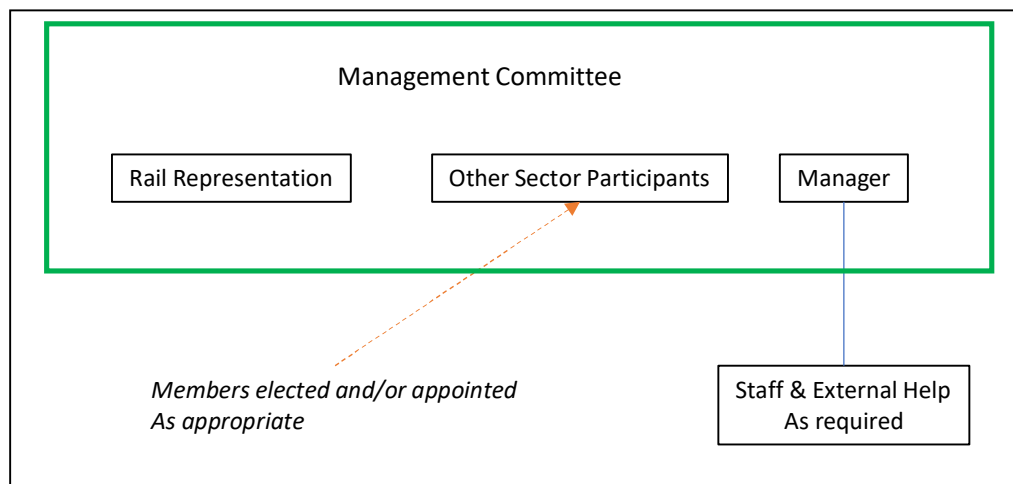
Funding:

- A fully independent manager (even if elected by a club) will need funding. The obvious source of funding is a small levy on all participating operators.

Functions:

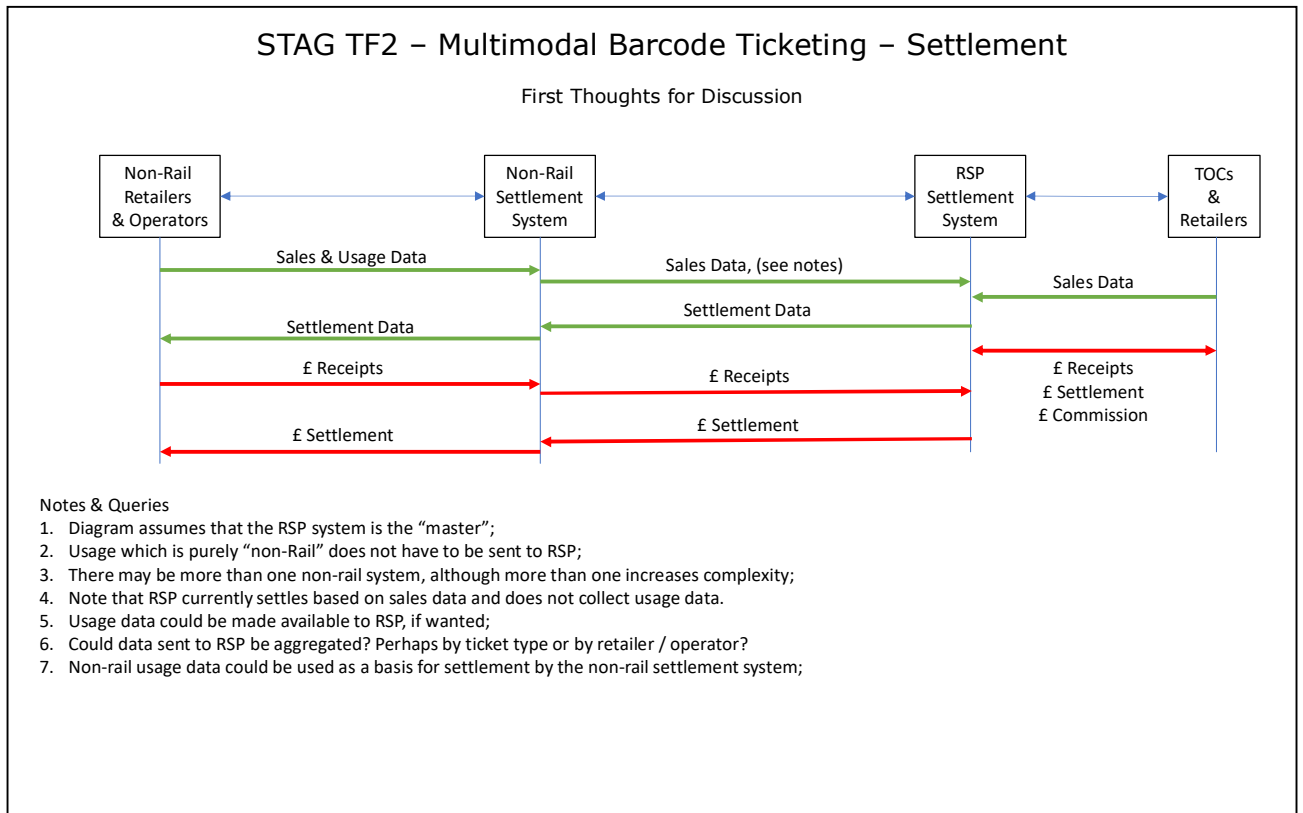
- Define operating rules and implementation guidelines / specifications (by agreement);
- Define and Maintain non-rail technical specifications (e.g. bus ticket barcode data formats);
- Liaison with RDG;
- Dispute resolution.

Possible Structure:



Annex 3 – Settlement - a Possible Arrangement.

Please note that settlement arrangements are work in progress, this diagram reflects the working groups initial thoughts.



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