Displaying Transport Information on Public Electronic Signs

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List of contents

1 Introduction

1.1 The issue

1.1.1 In the context of public transport, **real time information** (RTI) systems are those systems and services which enable passengers to have current ("live") information on the operation of their expected service – rather than merely hoping that the planned timetable is being met.

1.1.2 The most widespread and familiar form of RTI is the "countdown" service, in which an at-stop display indicates the number of minutes until the next numbered service vehicle will arrive. There are increasingly other options for providing live transport information, through services such as call centres and smartphone apps; but evidence from passenger groups such as Transport Focus suggests strongly that public-realm signage will remain a crucial part of the RTI context for a long time to come.

1.1.3 Signage technology, however, is not static, and neither is the technology for the central computer systems that drive sign displays. As innovation opens up new opportunities, people are starting to explore new ways of presenting live information on signs. Some of these are more successful than others, and there is a need to capture and promulgate good practice in this area. A common approach would also ensure that bus users around the country would have services that looked and felt similar.

1.1.4 In 2016 RTIG established a Working Group to consider these issues. It was quickly realised that the challenge has several dimensions, and separate advice was required on issues such as:

- The language and terminology used on RTI signage;
- How RTI data can be structured so that the information available through separate channels is kept consistent;
- How best to use newer sign technologies that enable full-screen displays;
- What kind of information bus users would best benefit from on signs.

1.1.5 The present document helps to address the third and fourth of these: it provides a brief overview of sign types and characteristics, and suggests an approach to prioritising information and presenting it on-screen. Companion documents are:

- RTIGT035, which covers language and terminology;
- RTIGT036, which covers the use of signs for additional information (ie not directly associated with specific services).

1.1.6 The guidance in this document should not be regarded as restrictive. Variation, and innovation, may be valuable in specific circumstances – although the considerations described herein should be borne in mind, to avoid creating confusion.

1.2 Scope

1.2.1 The primary scope of this document (and others within the same series) is fixed signage, located in the public realm and operated by local transport authorities, for the express purpose of providing RTIG. That includes at-stop signs but also includes signs in hubs (bus stations, rail interchanges etc) as well as "city-centre" signage on shopping streets, in malls etc.

1.2.2 By extension, this document also covers signage which is embedded into third party signs (eg as a virtual panel on a multimedia display) or services (eg as a panel in a third party web page). By further extension, it covers information which is presented by third party services (eg commercial apps).

1.2.3 The status of this document is **published**.

1.3 Acknowledgments

1.3.1 RTIG is grateful to the members of its Information Presentation Working Group for contributing to the construction and validation of this document.

2 Display choices

2.1 Introduction

2.1.1 Displays can be constructed using multiple different technologies all of which have their particular advantages and disadvantages. It is important that users understand the limits of any specific technology in terms of information display, since this inevitably determines what the display is capable of showing and the conditions under which the technology is viable.

2.1.2 In some cases it will be inevitable that technical choices limit display layout potential: for example a large flip dot sign, chosen to provide large text at a site where solar power is demanded, cannot be expected to scroll messages. Similarly, an at-stop monochrome LED sign is realistically unsuitable for complex graphics.

2.1.3 This section presents an overview of some key differences, and some recommendations on how this variation impacts on the specification, acquisition, deployment and operation of signs.

2.2 Tenders

2.2.1 Where equipment is specified – whether in an Invitation to Tender, or a tender response – the choice of technology should be made in accordance with the expectation of the display requirements and in the light of an understanding of the capabilities of the display technology options. Annex A provides a summary of the technical differences between some key display technologies.

2.2.2 Of course technologies can be implemented in multiple ways, and innovation continues to occur; often, therefore, it will be more appropriate for an ITT to specify requirements for what is to be displayed and to entirely ignore the technology type. In this way vendors can offer any technology capable of delivering the client's requirements, based on their sourcing opportunities and prices, available options for power/housing/mounting, system software design, and so on.

2.2.3 In addition to primary requirements for display functionality, other tender criteria that might be relevant considerations include:

- **Location:** A flag display is necessarily more constricted than a shelter or large bus station display.
- **Cost:** Clearly budget is a significant criterion. Aside from the capital cost of signs and the civil works associated with installation, there are also some technology-dependent factors affecting the ongoing costs:
  - **Power**: low power demand translates to lower ongoing costs; solar powered hardware may incur no power costs, and may save considerably on installation costs since it does not require mains cabling.
  - **Longevity**: Different technologies have widely different expectations with regard to expected operational lifespan, which may have very significant effects on lifetime costs
- **Internal savings**: a more sophisticated LCD display at a city centre stop may be able to save costs by showing information that would otherwise incur costs to distribute to the public.

- **Secondary benefits**: On-street hardware is essentially a computer with communications channels, which host to other valuable services such as radar systems for traffic monitoring, road surface temperature monitoring for gritter management, etc.

3 Message content and priority

3.1 General

3.1.1 Transport information should be presented in a consistent manner, so far as is reasonably practical, for all transport modes.

3.1.2 It is increasingly possible to provide displays capable of showing mixed content. There is also increased interest in revenue generation from advertising. When using displays for material other than that required for their primary purpose:

- Any additional information should not replace the transport data at any stage.
- Any additional information should not detract from the primary purpose of the display, whether by being too distracting or by occupying such a large area that it overly reduces the space available for the transport data.

3.1.3 Information presentation should comply with the requirements of the Equality Act 2010. Non-statutory guidance is provided in the RTIG document *Inclusive passenger information* (RTIG-PR003-D002).

3.1.4 The existence of legacy signage that is not of adequate quality should not limit the adoption of improved formats.

3.2 Screen layout

3.2.1 For simplicity, utility, and comprehensibility, the general screen layout for presenting normal service messages is hard to fault – a sequence of short lines, vertically aligned on the screen, in the order:

<Service identifier>	<Destination/route information>	<Timing information>
(Optional) <Additional service relevant information>		
<Service identifier>	<Destination/route information>	<Timing information>
...		
<Service identifier>	<Destination/route information>	<Timing information>
<Additional relevant information>		

Figure 3-1: General RTI display schema

3.2.2 In this structure:

- Display of the service lines will normally be in order of expected arrival at the stop, either by timetable time or by current live predictions, the earliest being at the top. The number of lines will depend both on what the sign is capable of, and how far ahead is considered reasonable in context; see also section 0.
- "Service identifier" will be route number or route name ("Line" in Transmodel terms), including public variants but not operational variants.

- "Destination/route information" will normally be the route termination, which may be stop specific (eg "station") or zonal (eg "city centre"); where route variation occurs, a "via" may be included. Full route details are too cognitively complex and should, where necessary, be included as an "Additional service relevant information" line. See section 3.4 for additional guidance on service content.

- "Timing information" will be either timetable time, live prediction, or both. (NB in the rail context there is normally no numbered/named service identifier, and the timetable time is used as a proxy service identifier. Trams and light rail vary.) Appendix B provides additional detail on timing presentation.

- Bottom line "Additional relevant information" can be quite flexible: the options will depend substantially on screen type.

3.2.3 In some circumstances, this sign layout may need to be temporarily subverted: see section 3.5.

3.2.4 There are many variations for the way in which timing information is displayed. Some common options are described in Annex B. Annex C describes a case study that demonstrates how significant this choice can be on the value of the service to passengers.

3.2.5 In general it seems to be helpful for the display to indicate both timetable time and live information. However, this may not be appropriate for very frequent services which are used by passengers on a turn-up-and-go basis. In particular, such services may be headway-managed rather than (publicly) timetabled, and in this context having both pieces of information is likely to be unhelpful or even confusing.

Loss of data

3.2.6 Should the sign fail to obtain any valid data, the display should show a suitable message, for example:

There is currently no information available

3.2.7 Where the technology supports it, this message may be augmented with other information such as:

This problem has been reported automatically and will be investigated

3.2.8 Automatically switching the sign off is not advised. However manually disabling the sign may be necessary if the nature of the error, and the system logic, leads to signs showing grossly misleading or inaccurate information (eg "next service at 00:00" for all routes, or "due in 999 minutes").

3.3 Selecting services to display

Daytime

3.3.1 During the "daytime" (ie operating hours, any time up to the overnight gap), there will normally be a steady stream of expected service arrivals. It may not be possible to display all of them, and how the display handles upcoming services will depend largely on local factors. There are a number of logical approaches:

- **Chronological cut off:** The simplest way to limit the display list is to show all services in order of arrival, stopping when there is no more room. However this may not be of best value to bus users when there are frequent services.
- **Limited time period:** Another simple way show services in order of arrival, for a fixed period ahead – say one hour. This suffers from a similar problem to the previous; the omission of farther-future services could be regarded as positive or negative, depending on context. Generally, displaying a service more than a couple of hours in the future is likely to be of minimal value.
- **First service of each route:** This approach is marginally more complex to arrange, but offers some advantages in that more unique services can be shown at any one time and for any given display format will show the maximum number of useful lines. (Variants could include first service for each destination, or for each corridor; where multiple operators run similar services, further options exist.)
- **Cycled display formats:** Whichever of the above options are chosen, displays may show more services by cycling through those that are in scope (however that is defined) but which are not shown if the sign is strictly restricted to one service per line. One common approach is for the last service line to cycle through additional services. In some circumstances it may be more appropriate to cycle the entire display. Where cycling is used, a page number should be shown on the "Additional relevant information" line.

3.3.2 Clearly, sign type and design need to be sufficient to show a reasonable amount of information to passengers. A stop where there are many frequent services, for example, may require a full-screen display, or risk showing only a subset of services for the next few minutes.

Night time

3.3.3 Most corridors will have a night-time period in which no services run. During this period, there are likely to be no further services in scope of the daytime algorithm (however that is defined), and a normal real time display would not be helpful.

3.3.4 One solution is of course to turn of the display at night. However in most cases it is preferable for it to show a suitable "holding" message, to reassure potential users that the sign is still operational. Examples are:

There are no services due in the next hour

and

Services resume at 05:47

3.3.5 The daytime display format should resume as soon as it can find a service "in scope" (so, if there is a one-hour cut off, and the first bus is due at 05:47, the daytime display would resume at 04:47).

3.4 Service message content

Normal operational conditions

3.4.1 The core of an RTI display is the current running of individual services (as indicated in Figure 3-1). At this point, the majority of travellers will know which service they are aiming to use, and when it might arrive. Journey planning advice is normally not appropriate for RTI displays, at least during normal operations.

3.4.2 The minimum content of the service line includes: service/route number or name; service destination/termination; and *either* scheduled *or* predicted calling time at the stop. In addition, it is highly recommended that the sign includes a clock display.

3.4.3 Where the sign style permits, the following additional information should be considered, in approximately this order (most important first):

- Accessibility features of the vehicle (in particular its suitability for wheelchair users)
- Bus fullness
- Operator name or logo
- Calling pattern or general description (for example, "express to city centre")
- Both scheduled and predicted calling time
- Noteworthy information on the route stops (hospitals, museums, landmarks, shopping, etc)
- Utility facilities (eg availability of WiFi)

3.4.4 Context will inevitably be important. For example, calling pattern will be particularly important if there are multiple services to the same destination that take different routes, if the service calling pattern varies over the course of the day/week, or if the service is operating a temporary calling pattern (eg during road closures, Christmas extensions, etc).

Disrupted conditions

3.4.5 During highly-disrupted conditions (eg heavy snowfall or flooding, where problems are severe and area-wide), particular protocols will apply, for example the use of whole-screen messages such as "major disruptions, see website for details". For these circumstances, guidance is provided in the RTIG document *Managing Bus Service Disruptions* (RTIG-PR015-D002).

3.4.6 However there are many lower levels of disruption, ranging from a few minutes of delay on a particular vehicle to corridor-level problems such as a road traffic accident. In these conditions the format of Figure 3-1 remains valid.

3.4.7 Where a service is **diverted**, additional service-specific information should indicate this fact. If the diversion applies on a longer term basis (for example in a temporary timetable), a bottom line message may also be appropriate, such as:

Services to the Hospital will not call at the Superstore during February and March

3.4.8 Conversely, where a bus stop is temporarily out of action, a message to that effect should be displayed at that stop. This message should indicate where the nearest alternative stop is located for each relevant service/route. Timetabled or live service timings should not be shown.

3.4.9 Where a service has been **cancelled**, it should still appear on screen along with its destination and scheduled time. However the word "Cancelled" should be shown on the service line. It may be shown in any of the following configurations:

- Alternating with the scheduled time
- Permanent in the live prediction time field (where shown in addition to scheduled time)
- Alternating with the "Destination/route information" field

3.4.10 There is no accepted abbreviation to the word "Cancelled", and the last option may be the only feasible approach for limited-character signs.

Audio renditions

3.4.11 The use of audio is covered in the RTIG guideline *Inclusive passenger information* (RTIG-PR003-D002). In summary, the audio may be natural speech or high quality Text to Speech and should render the same information as is displayed on screen.

3.4.12 Note that to clearly render the contents of the screen may require that the rendered text is not merely the text on the screen but a more complete series of sentences to provide the context which sighted travellers can see, this something like:

21B Hospital 09:48

might be spoken as

The 21B service to the Hospital is expected at nine-forty eight.

3.4.13 Spoken wrappers may also need to give context such as:

This is Stop X on the High Street.
The time now is nine-thirty seven.
Services from this stop are: ...

3.5 Additional relevant information

3.5.1 While there is a general consensus over what it is useful to show over service-related messages, there is much less consistency on how display screens are used to provide "additional relevant information".

3.5.2 It is suggested that there are some core general message types that systems should support, and that these should be also included in a consistent priority framework. This should simplify overall system engineering, including how signs and central systems share the management of displays.

3.5.3 To this end it is recommended that all systems support a minimum of four priority levels for "additional relevant information" messages, which might be categorised as:

- Priority 1 – emergency/critical
- Priority 2 – very important/urgent
- Priority 3 – important
- Priority 4 – routine

Systems capable of using a finer gradation would potentially need to cluster their message priorities in order to interwork, but four levels is considered to be the minimum reasonable range of effective public information presentation.

3.5.4 Table 3-1 below suggests some additional guidelines for how to characterise message priorities in a minimal four-level scheme.

Priority level	Display usage	Usage context
1	Occupies the whole screen until removed. Where possible this should use distinct "alarm" colours such as red, and be in large/bold font.	Extreme conditions where alarms and instructions must be sent to the public at large, not solely bus users
2	Occupies all or most of the services space and remains in place until actively cleared. The sign location banner, clock and a bottom line "ticker" for additional messages should remain operational.	When routine service data is rendered effectively unreliable for all or many services
3	Occupies a relevant faction of the services space, below or alternating with live information about the affected services. The sign location banner, clock and a bottom line "ticker" should remain operational.	When one or more services are subject to significant disruption: cancellation, delay or routing change.
4	Occupies only the bottom section of the screen and does not obtrude on the service area. For limited-line displays, the last line may be temporarily used, and then revert to service information once the message is no longer valid.	General information: upcoming timetable changes, preliminary event warnings, reminders on validity of ticket types, etc.

Table 3-1: Suggested approach to four-level (minimal) message prioritisation

3.5.5 For each message, the system should hold attributes for factors such as:

- the temporal validity of messages
- any relevant message sequencing information
- the geographical applicability of messages (individual sign, line of route, area-wide)

Note that different messages in a sequence might have different priority levels, and therefore might be handled differently.

3.5.6 Where more than one message is shown, the finish of one message and the start of the next must be clearly identifiable. One way to achieve this is to ensure the first is fully off screen prior to the second starting; other options are possible. (This will generally apply only to Priority 4, or occasionally Priority 3, messages.)

3.5.7 Defining which specific message falls into which priority category, on this scale or a finer scale, is a complex process and must respect scheme-specific factors. Annex E provides an example of how this might be done using a two-factor assessment of some common messages; the approach presented can however be adapted for local use.

A Comparison of display technologies

A.1 Introduction

A.1.1 When specifying a display to use, it is predominantly important to specify operational performance such as resolution, power usage and visibility (brightness and contrast). Maintainability issues, such as screen fogging or pixel death rates, are also important.

A.1.2 However, it can be helpful to have a basic understanding of the different technologies available, which will suggest their value for money in practice. This annex provides an overview of the technical characteristics of some popular display technologies[1].

A.2 Overview of display characteristics

A.2.1 Tables A-1, A-2 and A-3 below represent a simplistic summary of some key display types, using parameters that are of particular interest for RTI signage needs. This excludes older and less appropriate screen types (for example CRTs and plasma displays).

A.2.2 Of course individual product specifications will vary. Flip-dot (physical) displays, for example, can be engineered for anything from quite small "pixels", even enabling some font choice, up to large whole-character prisms. Something similar is true of digital displays too, with many low-cost LED and LCD applications (such as watches and calculators) still using seven-segment numbers.

Technology	Illumination	Power usage	Solar-power capable	Vandal resistance
Flip dot/prism	Reflective	Very low	Yes	Requires screen
LED				
Standard LED	Emissive	High	Marginal	Requires screen
OLED	Emissive	Unknown	Unknown	Requires screen
LCD				
Typical LCD (eg TFT)	Backlit emissive	High	No	Requires screen
Cholesteric (bistable)	Backlit	Low	Yes	Requires screen
LTN LCD	Reflective and emissive	Very low	Yes	Requires screen
e-ink	Reflective	Very Low	Yes	Requires screen

Table A-1: Display technologies – physical aspects

1 See also https://en.wikipedia.org/wiki/Comparison_of_CRT,_LCD,_and_plasma, which cites additional factors such as electromagnetic noise that may be relevant in some circumstances.

Technology	Resolution	Pixel size	Switching speed	Colour range
Flip dot/prism	Low	Large (~7mm)	Very slow	Usually monochrome (in principle any colour pixels)
LED				
Standard LED	Low	Med/Large (~4mm)	Fast (video-capable)	Many single colours; effectively full colour at low resolution
OLED	High	Small (~0.01mm)	Fast (video-capable)	Full colour at high resolution
LCD				
Typical LCD (eg TFT)	High	Small (~0.01mm)	Fast (video-capable)	Full colour at high resolution
Cholesteric (bistable)	Medium	Small/Med (~0.1mm)	Slow	Usually blue (on white); alternatives exist
LTN LCD	Low	Medium (~2mm)	Medium	Colourless – uses filters and lighting to colour
e-ink	High	Small (~0.05mm)	Slow	Monochrome

Table A-2: Display technologies – imaging capabilities

Technology	Backlighting	Contrast (normal)	Contrast (full sun)	Visibility at night
Flip dot/prism	No	High	High	With front light
LED				
Standard LED	N/A	High	Low	Good
OLED	N/A	High	Low	Good
LCD				
Typical LCD (eg TFT)	Yes	High	Low	Good (since backlit)
Cholesteric (bistable)	Yes	Medium	Medium	Good if backlit
LTN LCD	Yes	Medium	Medium	Good if backlit
e-ink	No	Medium/Low	Medium/Low	Front lighting (difficult)

Table A-2: Display technologies – lighting and visibility

Technology	Longevity
Flip dot/prism	Capable of extreme longevity if properly managed. Contrast does not reduce over time if kept clean.
LED	
Standard LED	Luminance declines slowly over time: typically by 50% in 5 years, though this depends on colour and how hard the LEDs are driven. Historically white has been short lived but this is improving; some colours may achieve 10+ years.
OLED	Recent technology: longevity issues not completely known, although some colours (particularly blues) are reported to 'fade' faster than others.
LCD	
Typical LCD (eg TFT)	Highly variable depending on quality of manufacture. Does not 'burn in' but may become patchy. 5 years is a normal safe estimate. Max brightness of backlights (LEDs) will diminish over time.
Cholesteric (bistable)	Medium lifetime.
LTN LCD	Long: estimated to be decades.
e-ink	Historically short (for RTPI may be as low as 1 year), and greatly affected by refresh frequency, although improvements are claimed. Contrast reduces with rewrites.

Table A-4: Display technologies – operating lifetime

A.3 Caveats

A.3.1 Display technologies are sophisticated, and still-developing, products. Not only are manufacturing methods changing, but even the basic science is far from static. For these reasons the tables above must be taken as a rough-and-ready snapshot only.

A.3.2 Aside from this, each class of display has technical variants with inherently different characteristics and capabilities. This is particularly true of the liquid-crystal display (LCD) class, although the recent emergence of OLEDs shows that other technologies also continue to have their disruptive moments.

A.3.3 Not all relevant environmental characteristics are shown in these tables. For example, LCD displays tend to suffer more from excessive exposure to very low or very high temperatures than other display types; on the other hand, their low power consumption means that self-heating is not a problem.

A.3.4 Further, the way in which technologies are currently engineered into products may be limiting. For example, OLED displays are currently focussed on the TV market, with a typical screen luminance of a few hundred cd/m^2 (compared to a few thousand for a typical industrial-grade LED screen). Current panels are therefore likely to be suitable only for indoor use, such as at enclosed bus stations, although this could easily change.

A.4 Naming confusions

A.4.1 Some caution may be required in understanding supplier offers, where named technologies have sometimes been confused or misleading.

- **"Plasma screen"**. Plasma displays were an early form of large colour panel which was used for televisions and public displays. True plasma technology suffered badly from screen burn, especially in outdoor environments, and early uses for information screens were largely unsuccessful (which is why we have not included them in Tables A-1 to A-3). However, the term "plasma screen" is still some sometimes mistakenly used to refer to LCD technology that looks similar (in TV format) but is technically very different.

- **"LED display"**. The phrase "LED display" is sometimes used for LCD displays which are backlit using LEDs, as opposed to being backlit by more traditional illuminators such as fluorescent tubes (now largely superseded). These displays are better described as "LED-illuminated LCD" or "LCD with LED backlighting", since the LEDs are rendering the images directly, and the performance (in terms of contrast, resolution, longevity etc) will still be determined primarily by the LCD component.

A.5 Conclusions

A.5.1 The discussion above shows that the display technology market is full of technical wrinkles, with no perfect solution for RTI displays and continued dynamic development in components and products. While it may be helpful for some buyers to research their chosen technologies, if only in order to ask pointed questions of the vendors, the key message seems to be that procurement should focus on specifying performance requirements (with relevant contractual underpinning). Indeed it may be helpful to allow suppliers to offer variants, in case there is a tangible benefit (for example significantly reduced cost, or lower power consumption for a much better legibility).

B Commonly used message formats

B.1 The format of live information ("real time") messages has been argued over for a long time. There are a few widespread conventions in the bus sector, including the use of "countdown" minutes for live information to distinguish it from timetable data (traditionally presented in a 24-hour clock format).

B.2 However, there are still divergences across schemes, across signs types and indeed against other transport modes. Common options are:

- ***Option 1:*** Show ONLY tracked services as countdown **NN mins** (to arrival or departure). This excludes any scheduled services that are not tracked and does not therefore provide a full and comprehensive list of all buses serving that stop.

- ***Option 2:*** Show Timetabled as **hh:mm** unless RT is available, where the RT is shown as **NN mins** (to arrival). This option is based around a countdown concept is probably the most commonly used approach but some areas have found this to be confusing to transport users who do not understand the difference between timetabled and RT services and find it confusing when the display changes from **Time** to **Minutes to arrival**.

- ***Option 3:*** Show Timetabled as **hh:mm** AND predicted arrival as **hh:mm** (two columns). This clearly shows the difference between Timetabled and RT services but does require additional space on the display. If there is no RT, only a Timetabled time is shown and the second column is blank. It is the approach most commonly used at rail stations.

- ***Option 4:*** Show Timetabled as **hh:mm** AND predicted arrival as **NN mins** (two columns). This clearly shows the difference between Timetabled and RT services but does require additional space on the display. If there is no live information, only a Timetabled time is shown and the second column is blank. It could be argued that the countdown approach to RT may be confusing when shown against a Timetabled time.

- ***Option 5:*** Show Timetabled as **hh:mm** OR predicted arrival as **hh:mm** (one column). This does not clearly show that a service is delayed, as there is no distinction between a timetabled time and a live prediction.

- ***Option 6:*** Show Timetabled as **hh:mm** AND predicted arrival as **"On Time"** if within a predefined on time window or **hh:mm** if outside the predefined on time window (two columns). This is a variation of Options 3 and 4 and has the benefit of providing a simpler message unless the service is running outside of a predefined on time window.

B.3 There is no clear evidence as to which is "best", and local familiarity will clearly play a part in selecting an approach. However there is some evidence that passengers generally find it more helpful if the display shows both timetable data and some indication of live timing (see Annex C).

C Case study: Norfolk County Council

C.1 NCC has a range of different electronic sign types in Norfolk and, until recently, the screen layouts on the signs looked pretty much the same as everywhere else in the UK. However, during a routine check of the screens, a bus user mentioned that while he liked having an electronic screen at the stop, he didn't understand what he was looking at on the screen or like the way it was presented.

C.2 Information has previously been shown using a "countdown" approach to present the predicted time at which a tracked service would depart the stop. Typically, this would run "5 mins" → "4 mins" → "3 mins" → "2 mins" → "Due". For journeys that were not tracked (for whatever reason), the scheduled departure time was shown. This created a combination of 'xx mins' and 'xx:xx' being shown together on the same screen, reflecting a variety of tracked and not tracked vehicles.

C.3 NCC looked into this further by having face-to-face discussions with the public and other stakeholders. The outcome was a complete rethink of how information was presented to passengers, and a change in how this is done.

C.4 Around 150 people in Norwich city centre were asked what they thought about the electronic screens. A range of people were included in the sample: young and old, regular bus users and occasional bus users, as well as those that rarely or never used the bus.

C.5 At rail stations, we have become accustomed to seeing train departures shown in the format of a scheduled time with an additional column showing an expected departure time. NCC therefore asked its sample of 150 people whether they preferred the existing 'countdown' approach or whether they would prefer a "railway-style" approach, in which an additional column was included for "expected departure time" (see Figure C-1 below).

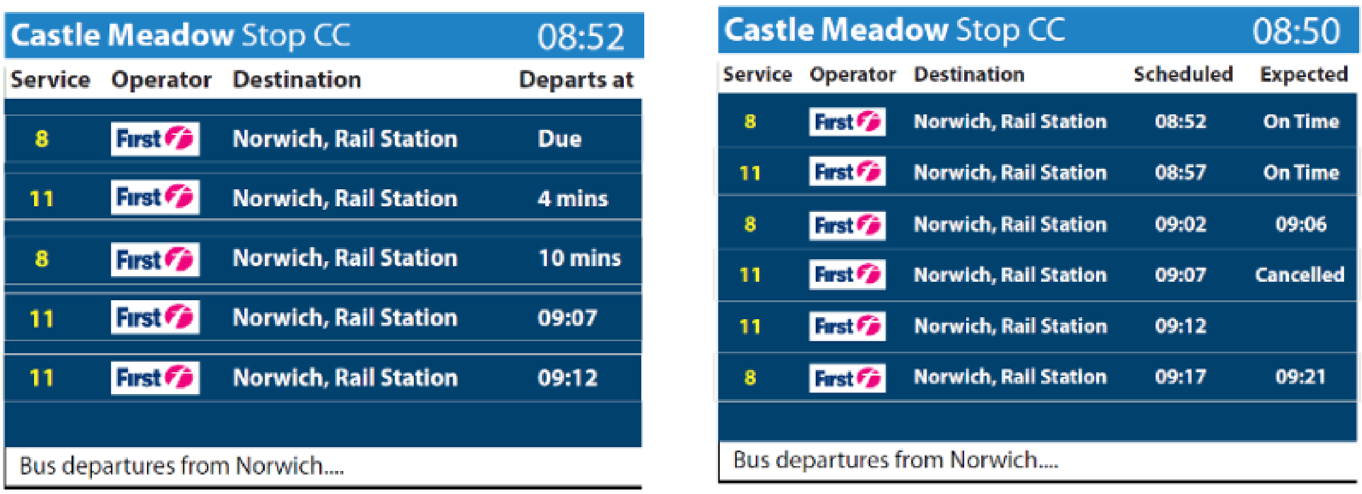

Figure C-1: NCC's bus displays – old (left) and new (right)

C.6 The results above show which of the two screen layouts was preferred overall, by regular bus users and those in different age groups. Notably, 46% of people overall felt that the 'railway' approach was better than the 'countdown' approach. In all but those aged 65+, there was a clear preference for the 'railway' approach. Additional comments made during the survey to support the 'railway' approach were along the lines of:

– "I can see more clearly what journeys are being tracked or not";

– "it's easier to see what specific journey the information relates to".

C.7 These findings were discussed with the main bus operators. There was initially some concern raised by bus operators about this approach highlighting poor performance more easily than previously, but the over-riding view was that if this was going to make it easier for passengers to understand travel information, then the way information is presented should be changed.

User group	Preferred old style display	Preferred new style display
Regular bus users (all)	30%	54%
Age <35	32%	54%
Age 35-64	35%	47%
Age >65	42%	38%
Overall	***36%***	***46%***

Table C-1: NCC survey results

C.8 Where space on the screen allows, all NCC's signs have now been changed over to the "railway" approach (Option 6 of Annex B), with an additional column being added to show an expected departure time.

C.9 Whilst NCC hasn't conducted a follow up survey, it has taken whatever opportunity it has had to ask people about the new layout on the street, at forum meetings or on the phone. What is reassuring is that the comments largely mirror those given during the survey, with the most common reply being that "it is much clearer as to which journeys are being tracked or not". Of particular note has been the reduction in complaints about the untracked journeys falling off the screen when the scheduled departure time is reached, suggesting the difference between tracked and untracked journeys is now becoming more understood.

D Case study: Transport for London

D.1 London has over 2,600 signs spread across approximately 19,000 stops. Most sign locations were selected during the Countdown II rollout programme in 2009 using a scoring mechanism built around a series of criteria that favoured stops with high annual boarder numbers, interchange or population centre locations. This approach was based on passenger research outcomes that although strongly favoured placing signs at all stops, concluded that with limited sign stock, locations of local strategic significance were more likely to capture one journey leg and present the most logical selection approach from a passenger perspective. Adjustments were made following stop scoring to ensure a fair geographical distribution across the London boroughs.

D.2 Real time information is available for all TfL's contracted services, so scheduled time is never used.

D.3 All London's LED signs have four lines and the default display format is as follows:

1	38	Victoria	due
2	19	Battersea Bri	due
3	22	Putney Common	4min
4	14	Putney Heath	6min

Figure D-1: Default TfL sign layout (mockup)

D.4 This layout has eight vertically-aligned columns, each of fixed character length. Size and alignment is as follows:

Field ID	Field	Characters	Alignment
1	Order of arrival	2	Right
2	<blank>	1	
3	Route Number	4	Right
4	<blank>	1 or 2	
5	Destination	15	Left
6	<blank>	1	
7	Arrival time	5	Right
8	<blank>	1 or 2	

Table D-1: Default TfL sign layout (specification)

D.5 The first prediction will be fixed on the top line with subsequent predictions rotating in blocks of two or three depending on whether the bottom line message is active. If the top line is cleared down, it will be immediately replaced with the next prediction and will not be left blank for the rest of the cycle. Predictions can be re-ordered during a full message cycle, but no predictions can be lost from re-ordering by moving up across the page boundary as a page turns. A maximum of 10 predictions are displayed in order of arrival, so three pages of four lines with the first line held. Each prediction page is displayed for 10 seconds.

D.6 Predictions can appear on signs up to 30 minutes before arrival and will count down to 'due' only (they never count up). A bus will go to 'due' 60 seconds before arrival time and will clear down 30 seconds after bus departure. If a bus is delayed, the prediction will freeze on the last prediction until the bus moves again. A bus breakdown, or similar situation when the bus fails to move will result in the prediction freezing and then being removed from the sign after 10 minutes. Curtailments or diversions will immediately remove the prediction from the sign.

D.7 While a bottom line message is displayed, three lines are used to scroll the 10 prediction cycle. The message will always start at the beginning of a message cycle and the predictions will revert to four lines at the start of the next cycle.

D.8 Although up to two messages can be displayed on the bottom line at any time, TfL applies tight policies around the use of bottom line messages to ensure that the four line display is preserved whenever possible. The focus is on journey specific service disruption messaging and non essential general messages are avoided. Message priorities can be set according to severity (TfL's message prioritisation policy currently goes as far as 7 with 1 being the highest). The intervals between bottom line message scrolling are configurable and a default value of 90 seconds is used.

D.9 All messages have the option of being displayed as a full matrix message on the sign. A full matrix message is only used when the predictions have no value, or the stop is no longer in use. This covers events such as stop closures, severe weather which severely impacts on prediction accuracy and the shutdown of an area during an emergency. It is assumed at all other times that the predictions remain relevant and highly valued by passengers so should not be compromised. Examples include during emergency situations when an area needs to be cleared quickly and during severe disruption when passengers use available real time information to negotiate around the disruption.

D.10 Standard message templates are used whenever possible to cover specific service disruption scenarios. The example below covers the relatively straightforward scenario of a stop closure (full matrix message if no routes serve the stop and bottom line message if some routes still serve the stop) and illustrates the range of content possibilities depending on the stop closure scenario. Other incidents such as diversions have a far more complex series of template message elements to cover a wide range of diversion scenarios.

Situation	**Mandatory wording template**
Bus stop closed; no alternative available	***Bus stop closed***
Bus stop closed; alternative available	***Bus stop closed. Use alternative stop at <stop name/location>***
Selected routes do not serve stop; no alternative available for these routes	***Routes <route IDs> are not serving this stop***
Selected routes do not serve stop; alternative available for these routes	***Routes <route IDs> are not serving this stop. Use alternative stop(s) at <stop name/location>***

Table D-2: Example of standard TfL disruption messages – stop closure scenario

E Example message prioritisation

E.1 Information types are required to be shown with varied urgency and importance. An imminent emergency is both urgent and important, whereas advertising is neither.

E.2 The following tool is designed to help system operators establish a structured hierarchy so that all users and systems in their area use the same approach to priorities and locations for different types of content thus improving passenger understanding and system effectiveness.

E.3 The following matrix is a simple tool to generate a priority hierarchy for information displays.

- In the first column is a brief description of the type of information to be displayed.
- *"Urgency"* describes, on a scale of 1 to 4, how urgent the information is (1 being most urgent, 4 least). In this example, 1 denotes information highly relevant to the next few seconds or minutes, while 4 denotes information that has no near-term reference (ie it would be just as relevant over the following days or weeks).
- *"Importance"* describes how important the information is to the intended recipient – ie generally to a (prospective) passenger. It is based informally on passenger information (including both local research and research by bodies such as Transport Focus).
- *"Product"* is the result or multiplying urgency and importance scores. This allows a display priority ranking to be established.

E.4 This model can be clearly adapted in many ways: changing scores, changing how they are combined, or (more drastically) changing the scoring parameters or the catalogue of information types. This allows users to select which types of information are more important or urgent within their own operational context – for example, locally, advertising may be more important than this model shows it.

Type of information	Urgency	Importance	Product	Notes/where displayed
Emergency				
Emergency requiring absolute priority (eg evacuation alarm)	1	1	1	Full screen, or all lines concurrently
Now and Today				
Routine live information	1	2	2	
Routine timetabled information	2	2	4	If live information not available
Single journey disruption	2	2	4	On "Journey" line (replace destination)
Single route disruption	2	2	4	On "Route" lines (replace destination)
Area-wide disruption	2	1	2	Full screen (alternate with live information)
Later than today				
Widespread disruption	3	1	3	Full screen (alternate with live information)
Route disruption	4	2	8	On "Route" lines (replace destination)

E Example message prioritisation

Type of information	Urgency	Importance	Product	Notes/where displayed
Journey disruption	4	2	8	On "Journey" line (replace destination)
Non RTI				
Change of timetable	4	2	8	Line 3/below current service lines (scroll or alternate)
Time (clock)	4	2	8	Line 3/below current service lines (scroll or alternate)
General local authority information	4	4	16	Line 3/below current service lines (scroll or alternate)
Advertising	4	4	16	As contracted

Table E-1: Example of a message prioritization approach