1. Introduction

In recent years cycling has moved up the political agenda in recognition of its potential to contribute to a range of non-transport as well as transport objectives, notably health and climate change. In recognition of this, national policy is moving towards a more pro-active encouragement and enabling of more people to cycle rather than simply accommodating existing levels of cycling. Comparison with other European countries and examination of travel statistics indicates a substantial potential to increase cycle use in the UK. However, very often traffic signals schemes focus on the needs of motor vehicles and pedestrians with little attention being paid to cyclists.

This paper summarises a range of good practice examples that illustrate the role signal engineers can have in creating an environment that encourages more people to cycle through the provision of safe and convenient routes, both on and off carriageway, and considers how this might develop further in the future. The presentation will include photographs illustrating many of these schemes.

2. Context

Potential for Cycling

There is considerable potential to increase levels of cycling in the UK, as illustrated by the following statistics:

- 60% of car trips are under 5 miles
- Nearly half of all trips are under two miles long
- Some 2% of trips in the UK are by cycle, compared with 5% in France and Italy and between 8% and 10% in Belgium, Switzerland, Austria and Germany.

There is good evidence to indicate that cycling gets safer the more people do it. Recent work by CTC, the National Cyclists’ Organisation, brings together evidence for this ‘safety in numbers’ effect in the UK and elsewhere in Europe.

Benefits of Cycling

Cycling England’s report in 2007 on Valuing the Benefits of Cycling concluded that increasing cycling levels by 50% would benefit the economy by £1.3bn, through valuing the outcomes from:

- Health and Fitness
- Pollution reduction
- Congestion

DfT’s 2009 WebTAG Guidance on the Appraisal of Walking and Cycling Schemes includes three case studies that illustrate that very large benefit to cost ratios of between 18 and 38. This guidance takes account of:

- the impact on accidents
- journey ambience
- health benefits
Encouraging more cycling

Experience in other European countries and more recently in the Cycling Demonstration Towns demonstrates that substantial increases in cycling require a serious level of investment backed by leadership at a senior level to deliver an integrated package of many different, complementary, interventions including:

- Safe and convenient cycle routes that give advantage to cyclists
- Programmes to promote cycle use working with local partners
- Supportive land use planning and restrictions on car use

Cycle users vary in experience, with the more confident commuters using the most direct, if busy, routes, whilst the less experienced cyclist will prefer quieter roads or traffic-free cycle tracks even if they are less direct.

Nevertheless, most cycling is on the highway, and even those who avoid main roads will make regular use of traffic signals at least to cross busier roads.

Opportunities

Current opportunities that support increased levels of cycling include:

- Building Britain’s Future: National Cycle Plan and Active Transport Strategy
- Cycling City and Towns programme (Cycling England)
- Healthy Towns programme
- Sustainable Travel Towns programme
- Cycling Super Highways (TfL)
- Sustrans Connect2 Projects

3. What we do now

3.1 Scope

As part of my role within Sustrans, and as coordinator of Cycling England’s professional support service with a particular involvement in the Cycling City and Towns programme, I am keen to collect and disseminate examples of traffic signal schemes that have been well designed to meet the needs of cyclists, particularly where this involves innovation and imagination within or beyond current design standards.

Often good cycle provision is simple to provide if incorporated at an early stage in the scheme design, and engaging early in the process with your cycling officer and through them with local cycling stakeholders can assist greatly in identifying opportunities. Of course there is no substitute for riding existing and potential cycle routes yourself to ensure you understand their deficiencies and opportunities.

This section briefly describes a variety of UK schemes that assist cyclists at traffic signals that could be seen as good or innovative practice. The list is not exhaustive but should give a feel for the range of initiatives.

I would be pleased to receive details of any further examples you consider to be best practice, for possible inclusion in the Scheme of the Month slot on the Cycling England website.

3.2 Cycle Crossings

Minimising delay for cyclists at stand alone Toucans

Toucans that have a long delay time before giving a green to cyclists once a demand has been registered cause frustration and lead to frequent attempts to cross before the green light appears.
In Exeter, if a Toucan (or Pelican) crossing has not registered a recent demand to cross, it will react immediately to a cyclist or pedestrian demand regardless of traffic flow. This is due to operating these crossings on a pre-timed maximum rather than vehicular activated mode, such that the controller starts to count down from its maximum value as soon as the traffic phase gains right of way.

**Wide single stage Toucans**

The latest DfT guidance (LTN 2/08 Cycle Infrastructure Design) states that “staggered or split crossings are not generally recommended for cyclists, because they can cause delay to people crossing and give rise to potential conflict between cyclists and pedestrians”.

LTN 2/95 recommends that if a road width is greater than 11m a staggered layout should be considered, and if it exceeds 15m a staggered crossing layout should be provided.

There are an increasing number of examples of single stage Toucan crossings over dual carriageways and other wide roads which operate satisfactorily, where the local authority is serious about giving advantage to cyclists.

Cycling England’s advice is that where a Toucan crossing is required on a wide road, a single-stage crossing should generally be provided for widths below 15m. For widths over 15m, the option of a single-stage crossing should be fully considered in the light of existing examples.

Where a two-stage Toucan operates under SCOOT, delays for cyclists may be increased. However, it is possible to improve its performance for cyclists by considering it as a multi-node, in effect treating both halves as a single crossing.

**Providing good access to / from Toucans for all movements**

In addition to providing a safe and convenient crossing for cyclists on traffic free routes, a Toucan crossing should also take account of the demand for cyclists wishing to join or leave the carriageway at the crossing. Whilst joining the carriageway can generally be done direct from the crossing manoeuvre, cyclists leaving the carriageway to access the Toucan need a separate slip off the carriageway in advance of the crossing if conflict with pedestrians or cyclists waiting to cross is to be avoided.

**Cycle detection at Toucans**

In addition to the push buttons at Toucans, an increasing number of schemes are including detection loops or above ground detection on the approaches, positioned such that the lights change as the cyclist arrives there.

**Use of high level nearside displays on Toucans**

Where Puffin technology is used incorporating nearside displays at Toucans, the display can be masked by a group of cyclists / pedestrians. This can be addressed using the option of a second higher level signal.

**Diagonal Toucan crossings**

It is important that a Toucan crossing is located on the desire line of cyclists and so aligns with the traffic free route on either side of the road. Where the routes either side are not directly in line, the crossing may need to be at an angle if an awkward dog leg on a shared use footway is to be avoided. A good example is on Fen Causeway in Cambridge, where the cycle routes on either side of the crossing are on opposite sides of a bridge over a stream; so as to avoid cyclists having to use the footway over the bridge, the crossing is at an angle diagonally across the bridge.

**Cycle Activated Traffic Signs at Crossings**

This crossing helps cyclists travelling to East Midlands Airport to cross the busy A453 safely and, whilst not a signal controlled crossing, is a development likely to be of interest to signal engineers involved in designing cycle crossings.

In order to overcome limited visibility on this derestricted road, Leicestershire County Council installed the first CATS (Cycle Activated Traffic Sign) crossing in the world. The crossing uses pressure pads to activate a sign with flashing amber lights and a ‘SLOW DOWN’
message for traffic approaching on the A453. If a cyclist rides over the pad (or waits to cross) at the same time as an approaching car is detected by the sign’s radar, the sign is activated. The lights warn drivers so they slow down but the cyclist at the CATS crossing is unaware that a sign is being activated down the road and so proceeds with the same level of caution.

The crossing went live in September 2006 and initial results during speed monitoring exercises show a 10% reduction in average approach vehicle speeds when the CATS are activated. This means most vehicles are travelling at just over 40 mph past the crossing.


**Incorporating cyclists in UTC / SCOOT**

SCOOT has become an important tool for optimising the movement of traffic over the road network, although by doing so it may lead to additional delays for cyclists crossing at Toucans. However, whilst not often applied, there are ways in which SCOOT systems can be more cycle friendly, such as:

- Switching SCOOT off when traffic flows are low, rather than just using a fixed timetable;
- Consider double cycling Toucan crossings under SCOOT operation;
- Using the gap-out option allowing a signal site (e.g. a Toucan) to operate partly on SCOOT and partly on local isolated mode.

**3.3 Cycle Provision at Signalled Junctions**

**Cycle bypass (for left turners) at signals**

Where space and level of pedestrian use allow, it is often possible to provide a slip off in advance of a signalled junction, leading to a short section of cycle track that enables the cyclist to turn left regardless of the signals (or to continue straight ahead at the top of a T junction); care is needed in designing how cyclists rejoin the carriageway with a protected entry preferred.

**Early start for cyclists at signals**

In 1999 the Glasgow City Council opened the Colleges’ Cycle Route, a largely on road scheme which links the universities and further education colleges. A feature of this route is a separate cycle phase at the signals on Churchill Drive, giving cyclists a 6 sec start over other traffic so as to protect them from left turning vehicles.

**Exemption for cyclists from banned turns**

There are many examples of cyclists being exempted from banned turns at signals. Where there is a bus-only movement it should normally be feasible and desirable also to include cyclists. However, there will also be situations where a cycle-only exemption is appropriate as a movement banned for all motor traffic provides a valuable connection for cyclists.

**Advanced Stop Lines**

An Advanced Stop Line (ASL) with a cycle feeder lane enables cyclists to pass queuing motor traffic on the approach and take up the appropriate position for their intended manoeuvre before the signals change to green. They are established practice in most highway authorities so just a few comments are appropriate:

- They have little or no affect on capacity if the number of general traffic lanes remains unaltered
- Some local highways authorities now have a presumption to install ASLs at all signalled junctions
- A wide advisory cycle lane, accepting that some vehicles may encroach, may be better than a narrow mandatory lane.
- The benefit of an ASL can be much reduced if no lead in lane is provided.
- The design of an ASL must be site specific.
• Consideration should be given to factors such as the location and number of lead in lanes and part-width ASLs, which may require authorisation.

**Location of loops to detect cycles**

On approaches to ASLs, it is important that detection loops are positioned so that they cover the approach cycle lanes as well as the general traffic lanes; often this is not the case, resulting in approaching cyclists not being detected. Similar considerations apply to above ground detection.

**Intergreens for cyclists**

Cyclists coming through a signal junction at the end of the green phase may be travelling rather slower than motor traffic; this may be affected by the gradient or the route they are taking through the junction. This need not alter the calculated intergreens but can be addressed by including an all red extension when a cyclist is detected who has not cleared the junction, which prolongs the intergreen accordingly. This will improve the safety of cyclists using the signals.

**Permanent green cycle signal on bus gate**

Increasingly traffic signals are being used at bus gates to provide queue relocation on the approach to a signalled junction. Several cities, including Cambridge, have incorporated a permanent green cycle aspect on the bus gate signal as there is no need to stop cyclists when other traffic has a green.

**Permanent green cycle signal to access ASL**

At Monkgate Bar, one of the gates in the historic city wall at York, the restricted width means that motor traffic has to wait at the red signal before it goes through the gate to the junction beyond. However, there is room for cyclists to pass through when traffic is entering from the other direction so cyclists are offered a permanent green signal permitting them to pass through the city gate and then wait in the ASL just beyond.

**Cycle provision at signalised roundabouts**

Large roundabouts are an obstacle for most cyclists. However, signalising them assists cyclists by introducing control of the main traffic movements. To accommodate cyclists using them, ASLs should normally be considered for each entry arm and if stacking space permits ASLs may also benefit cyclists on the circulatory carriageway.

Less experienced cyclists are likely to prefer an off carriageway route around the roundabout, with signal control across the busier entries and exits. Temple Quay in Bristol provides both options.

At large signalised roundabouts where there is a heavy cyclist demand for a right turn, it may be feasible to incorporate a short section of cycle track in the central island that is linked into the junction phasing to enable cyclists to make the right turn more directly. An example is for cyclists turning onto Lambeth Bridge in London.

**Separately signalled cycle phases at signals**

A specific signal phase for cyclists can be useful, for example:

• Where cyclists can undertake a manoeuvre not permitted for general traffic, and which cannot be shared with pedestrians, such as crossing between the carriageway and a cycle track on the other side of the junction.

• Where cyclists are separated from other traffic for safety reasons; cyclists continuing ahead on Hills Road in Cambridge have a phase that runs separately from that for traffic on the same approach turning left into Brooklands Ave.

**Uncontrolled cycle crossing at signalled junction**

At some signalled junctions operational considerations may make it very difficult to justify a separately controlled crossing for cyclists. In such cases it may be appropriate to consider an uncontrolled cycle crossing of an arm of the junction, with the cycle track approaches marked as give way. This also has the advantage that cyclists are not faced with a full red signal at a time when it is quite safe for them to cross.
**Diagonal cycle crossing stage during all red**

Where there is a demand for cyclists to cross a four arm signalised junction diagonally, providing a direct diagonal crossing may be preferable to directing them across one arm at a time. If pedestrians cross on an all red stage, it may be feasible for that to incorporate a diagonal cycle crossing. Omagh and Birmingham both have signalised junctions which incorporate diagonal crossings for cyclists.

**Guiding cyclists through junctions**

Where a cycle phase is included at a signalised junction there may be benefits in highlighting this through the use of Elephants’ Feet markings (WBM 294), which need DfT authorisation.

4. What we might do

This section identifies a range of further initiatives that could assist cyclists but which have not (to my knowledge) been trialled in the UK. Some of these could be introduced under current regulations and equipment, whilst others would entail substantial changes.

**Incorporating cyclists in UTC / SCOOT**

At present options are available that enable these systems to incorporate bus priority. Future developments could see them developed to be more cycle friendly and possibly incorporate priority for certain key cycle movements.

**Pelican crossing that defaults to pedestrian phase when no traffic demand**

In 1997 Hull introduced two pedestrian priority signals in the city centre. These signals operate by reversing the conventional priorities and giving pedestrians the default green whilst vehicles wait at the stop line before being detected. It is an unusual location with low traffic flow (90% buses) and very high pedestrian volumes. There could be situations where such provision could be provided at a shared cycle and pedestrian crossing.

**All red stage for motor traffic with all green stage for cyclists**

A number of cities in The Netherlands have junctions that include an ‘all green’ stage for cyclists whilst motor traffic has an all red. Possibly a similar arrangement could be considered in the UK during an all red stage, subject to cyclists having to cede priority to pedestrians.

**Separate low level signals for cyclists on primary signal pole**

Many other European countries provide smaller signals at a lower level for cyclists. These are easier for cyclists to see and would open up options for separate sequencing for cyclists.

**Cyclists can turn left (right in mainland Europe) on red**

Some other European countries are trialling cyclists turning right on a red signal, but having to give way to pedestrians and other traffic. There is some interest in similar provision for cyclists in the UK. This can be seen as an extension of the flashing amber used in several European countries.

**Green light count down markers on approach to traffic signals**

A scheme trialled in Odense, in Denmark, provides a series of marker posts on the approaches to signalised junctions, incorporating green LEDs. These LEDs come on in sequence prior to the approach receiving a green signal, such that if an approaching cyclist keeps pace with the LEDs that are lit, then they will reach the signals as they turn green.

**Series of linked signals timed to give green wave for cyclists**

TfL and LB Camden are currently working on a trial scheme for Camden High Street that will link traffic signals and pedestrian crossings so that a green wave is provided if vehicles drive through at 20mph. Such a scheme is likely to benefit cyclists through reduced travel times as well as the wider safety benefits from lower speeds. If this proves successful there may be situations where it could be appropriate to design for a green wave at say 15mph, which would benefit more cyclists. In Copenhagen signals along several of the city’s main arterial roads are set to provide a green wave for cyclists maintaining a speed of 20kph.
Permitting right turn in two stages, with intermediate waiting area in advance of ASL

Standard practice in Denmark is to assist cyclists making a left turn (equivalent to a right turn in the UK) in two stages. Initially cyclists move forward part way across the junction and are able to wait ahead of the stop line and pedestrian crossing of the adjacent approach whilst that has a red signal; during the next stage, when that approach is green, these cyclists are able to complete their manoeuvre.

Linking 2 stage Toucans

Where a Toucan crossing is provided in two stages, technically it is likely to be feasible to link them such that a call on the first one triggers a demand on the second as well, timed to enable the cyclist to cross in a single manoeuvre.

5. Conclusions

There is a wide variety of examples of good practice in the provision for cyclists at traffic signals. However, whilst some such as ASLs have gained broad acceptance, others are notable by their rarity.

Cycling is moving up the political agenda, and national policy is moving towards a more pro-active encouragement of cycling. This paper aims to raise signal engineers' awareness of some of the high quality provision for cyclists in the UK, and to encourage them to increase the priority and consideration given to cycles at traffic signals. The needs of cyclists should be considered at least as much as for motor vehicles and pedestrians.

Often these schemes are simple to provide if incorporated at an early stage, and engaging early in the process with your cycling officer and through them with local cycling stakeholders can assist greatly in identifying opportunities. However, there is no substitute for riding existing and potential cycle routes yourself to ensure you understand their deficiencies and opportunities. If you have not cycled for some years, you might benefit from a refresher cycle training course.

For those already committed to making serious provision for cyclists, some ideas have been put forward on potential future developments. Examples of innovative schemes to assist cyclists at traffic signals are invited for the Scheme of the Month slot on the Cycling England website.

Cycling England’s Professional Support Service offers up to five days of technical support to (English) Local Authorities with a particular focus on schemes that contribute to Cycling England’s priorities of leverage, impact and focus. For more details see: www.dft.gov.uk/cyclingengland/encouraging-cycling/professional-support/

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