BUROHAPPOLD ENGINEERING

B&NES Parking Study

Parking Technology

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Glossary

Term	Definition
B&NES	Bath and North East Somerset Council
ANPR	Automatic Number Plate Recognition
RFID	Radio-Frequency Identification
VMS	Variable Message Signs
SMS	Short Message Service

1 Introduction

As part of the development of the future Parking Strategy for B&NES Council, BuroHappold has studied the potential future use of technology and real-time information for parking in the area. The introduction/increase of such technology may have a number of benefits, both for parking management and users, including significantly improving the user experience of parking in the B&NES area, and also helping B&NES Council to alleviate congestion within the area – in particular congestion associated with those looking for a parking space. Parking technology is also likely to support many proposals and policies within the other chapters of the B&NES Parking Strategy, as it may allow easier implementation and lead to more successful results.

1.1 Our approach

Our approach to this topic began with a review of what technology currently exists to support the parking system in B&NES – this review is important as any alternative technology proposed should ideally work alongside anything that is existing. This was followed by setting out the objectives and requirements for the system, which were then used to consider what alternative technologies are required by B&NES Council to meet the objectives.

This chapter concludes with a recommendation as to what kind of technologies B&NES Council could employ to meet the objectives for the technology. A roadmap has then been created that will guide B&NES Council through a number of recommended steps for implementation.

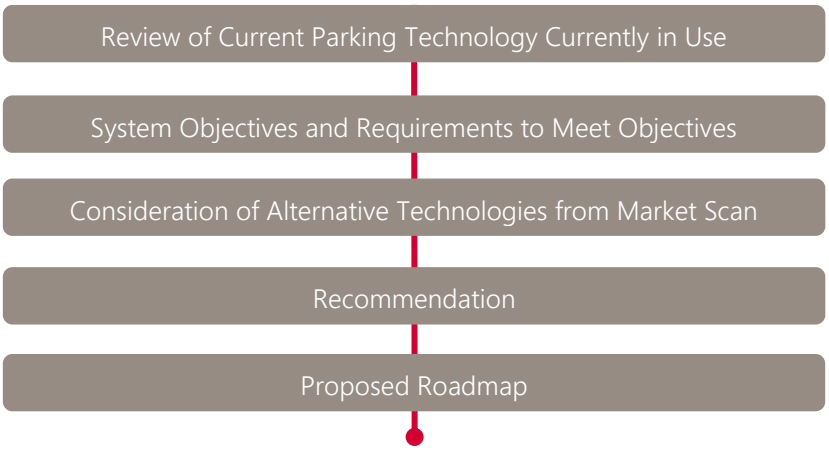


Figure 1-1 - Methodology of Parking Technology Note

1.2 Review of Parking Technology Currently in Use by B&NES Council

Some parking technology is already in use by B&NES Council, including a Variable Message Signage (VMS) system and also a cashless parking payment system called MiPermit. Details of these systems and their application in the B&NES area are as set out below.

1.2.1 Variable Message Signs (VMS)

Variable Message Signs (VMS) are electronic traffic signs that are used to communicate a range of information to travellers. The information communicated to travellers is likely to differ depending on the location of the VMS. For example, VMS used on highways is often used to inform travellers of events including traffic congestion, road accidents and speed limits. Within urban areas VMS tends to be used primarily to communicate parking guidance and information to travellers.

Bath has a VMS system which consists of 13 signs in total. There are currently 9 VMS signs within the urban area of Bath city centre, shown in Figure 1-2, these signs show occupancy data on the way to the car parks in Bath to allow drivers to choose which car park they wish to use depending on how many spaces are available for parking. These signs help to alleviate traffic queuing and circulating within the centre of Bath. In the past these signs have been linked with a private car park in the centre of Bath, Southgate. This link currently is not working due to a system change at Southgate, but it does signify that there is a possibility to include more private operators on the signs in the interests of improving traffic flow in the centre.

Figure 1-2 - Existing VMS in Bath

The outer VMS system consists of 4 signs displaying information including: parking availability, congestion, accidents, roadworks and events.

1.2.2 MiPermit

B&NES Council currently use an online portal called MiPermit to manage parking payments and permits. This can be accessed through a website and is also available as a smartphone app. Users can either set up an account with their personal information or can use certain features (such as pay for parking and season tickets) as a guest user. This portal offers two key features, cashless pay and stay parking and virtual permits, each of which are detailed below.

1.2.2.1 Cashless Pay and Stay Parking

Drivers can use MiPermit to pay parking charges in participating Pay & Display car parks using SMS, MiPermit's smartphone application, online or by telephone. In order to use this function, end-users can set up an account with MiPermit which allows their details to be remembered by the system to allow regular seamless payment. Alternatively, end-users have the option to not register an account but this will require them to enter their vehicle and payment details each time the portal is used.

To use the cashless parking feature for the first time, the driver can send an SMS to MiPermit with their vehicle registration number. MiPermit will then call the parker back using an automated system to request the car park location number, the payment card details for the parker, and will ask whether the parker wishes to receive a SMS reminder 20 minutes before the stay duration expires.

For those who have already used and registered for an account with MiPermit there are a number of options to use the service: using the telephone, SMS, online or using the smartphone application.

1.2.2.2 Virtual Permits

This feature of MiPermit provides access to Residents Permits, Season Tickets and Visitors Permits (as well as Christmas Market Coach Permits). The Resident and Visitor Permits require a Council Tax number, house number and postcode to register for a permit. These permits allow permit holders to park without paying at designated locations and also allow use of extended services, such as bus passes, for local authorities.

1.3 Objectives of Future Parking Technology

1.3.1 Introduction

This section of the note highlights the key objectives that the use of parking technology is required to meet. These objectives, identified and established by B&NES Council within the brief, focus on management of the City's transport objectives and supporting B&NES Council operations. It was noted that the success of achieving these objectives would largely benefit B&NES Council and hence BuroHappold have suggested an additional list of objectives that relate to improving the end-user experience. All objectives for the system have been split into these two categories and are set out below, followed by a list of requirements for the system against which alternative technologies can be assessed.

1.3.2 Objectives

Objectives for a parking technology system for B&NES Council have been split into B&NES Council Objectives and End-User Experience Objectives and are set out in Table 1-1 below.

CODE	LABEL	FULL OBJECTIVE
O1	**B&NES COUNCIL**	**Management of the City's transport objectives and to support B&NES Council operations;**
O1A	Minimise Resourcing	Minimise council resourcing (staff time) potentially by the use of sensors and cameras;
O1B	Optimise Usage	Minimise use of existing physical infrastructure and optimise usage;
O1C	Sustainable Travel	Encourage more sustainable travel;
O1D	Revenue Collection	Increased opportunities for revenue collection.
O2	**END-USERS**	**Objectives to Support an Outstanding End-User Experience**
O2A	Availability	Identification of and seamless guidance to the nearest available parking space;
O2B	Access	Access to a range of B&NES Council parking facilities;
O2C	Payment Options	A range of easy to use payment options available.

Table 1-1 - Parking Technology Objectives

1.4 Requirements to Achieve Objectives

Following on from the identification of objectives for the parking technology system, a list of requirements for each objective is set out in Table 1-2 below. These are intended to enable an assessment of potential technologies and to assist B&NES Council in determining a preferred parking management system for the area.

CODE	LABEL	REQUIREMENT TO ACHIEVE OBJECTIVE
O1	**B&NES COUNCIL**	**Management of the City's transport objectives and to support B&NES Council operations;**
O1A	Minimise Resourcing	• The system will detect the occupancy of parking spaces and will minimise the need for frequent re-calibration; • The system will collect and collate all occupancy data and allow monitoring and analysis of the parking stock; • The system will allow occupancy data to be sent to parking officers hand-held devices; • The system will allow parking officers to identify those who are illegally parked.
O1B	Optimise Usage	• The system will, where possible, eliminate the need for unnecessary parking infrastructure such as parking payment machines and barriers; • The system may over time reduce the strain on current parking infrastructure by improving the efficiency and utilisation of the existing parking stock.
O1C	Sustainable Travel	• The system will reduce the trip length of end-users looking for a parking space by identifying available spaces and guiding end-users to them; • The system must mitigate an increase in trips made to/within B&NES area by car; • The system may discourage those travelling by private car by making end-users aware if there are a limited number of parking spaces available; • The system may encourage end-users to travel by more sustainable modes of travel by promoting modes that are cheaper or easier to use.
O1D	Revenue Collection	• The system will increase the likelihood of a wide range of end-users being able to pay for parking by offering a range of payment options; • The system will enable B&NES Council to introduce dynamic pricing if desired/required; • The system will connect and interface with the existing parking technology used by B&NES Council, including the MiPermit booking and payment system.
O2	**END-USERS**	**Objectives to Support an Outstanding End-User Experience**
O2A	Availability of Spaces	• The system will use geo-location data to identify the nearest available parking space to the end-users; • The system will allow seamless guidance to the nearest available parking space through both personal technology and signage;
O2B	Access	• The system will allow the end-user to access information on B&NES Council's parking facilities; • The system will allow the end-user to gain physical access to B&NES Council's parking facilities;
O2C	Payment Options	• The system will provide a range of cashless payment options to end-users, that can be accessed;

Table 1-2 - Requirements to Achieve Objectives

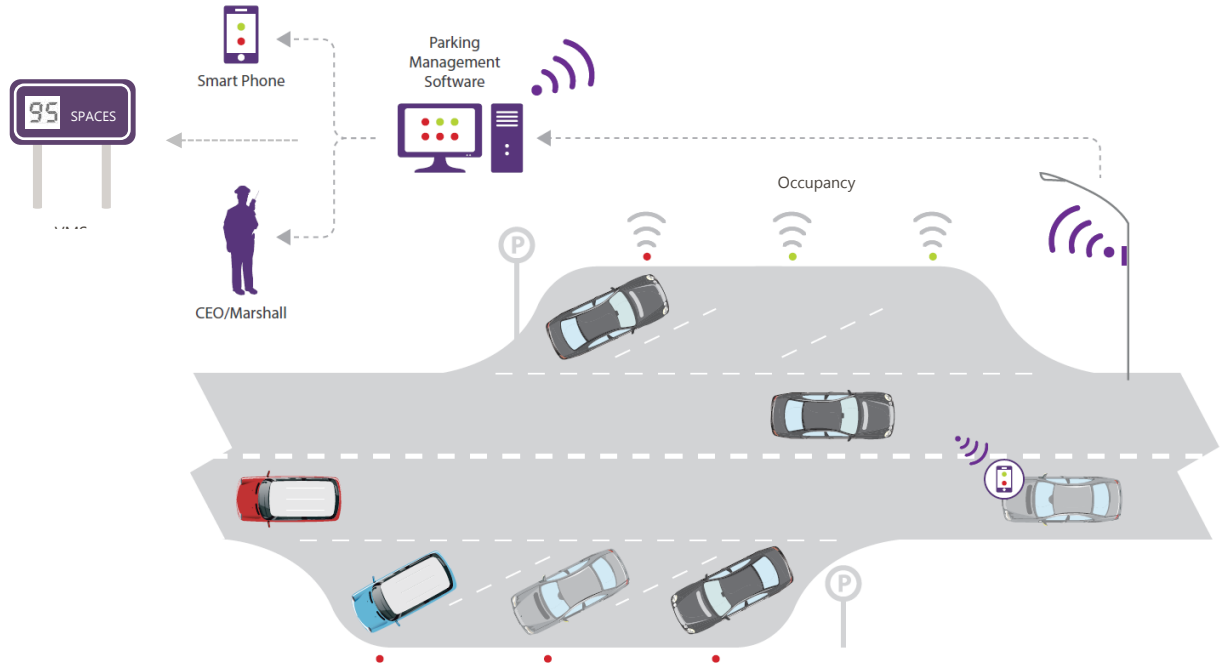
2 Consideration of Alternative Technologies

2.1 Introduction

A market study has been undertaken to consider alternative types of parking technologies and how they might improve the efficiency of the Council's parking facilities and performance against the previously identify objectives and requirements. These are set out more in the Appendix and detailed below.

2.2 Components of a Parking Management System

In carrying out the market study, it became clear that there a number of components to the most common, successful parking technology systems.



As illustrated in the figure above, a number of components can link to and feed into one another to create a complete system. This creates what could be termed a parking 'ecosystem' and creates a seamless user experience for all involved – from end-users looking for the nearest available parking space, to parking officers looking for cars that are illegally parked to those working within the Council on parking strategies and real-time management.

It is very common to find a holistic parking technology system, which consists of a number of elements:

- Occupancy detection system track the occupancy of individual parking spaces and entire parking facilities;
- Payment systems process transactions and then send data to data management software;
- Occupancy data and payment data are sent to data management software and collated, then this information is sent to:
  - Variable Message Signs;
  - Data user platform for both parking officers and end-users;

There are a number of other components that may complement this holistic parking technology system that are also explored within this section, including:

- Payment machines;
- Fixed vehicle and pedestrian signage;

Each of these components is explored in this section, which provides some detail on the key features and also the potential advantages and disadvantages of each element. Following on from this section the report makes a recommendation as to what kind of technology is recommended for B&NES Council to achieve the objectives that are set out for the system.

2.2.1 Parking Bay Sensors

Sensors installed either on the ground within a parking space or on a rail above parking spaces are commonly found in parking technology systems. The technology itself is relatively simple in that it detects the presence of a vehicle and feeds this data to a central database and then to real-time signage, but the convenience it could provide to B&NES Council and those parking is much more significant. When the sensor data is sent to the central database, it allows the car park owner/operator to form a clear picture of the real-time occupation of the car park. The table below shows how well this technology meets the various objectives set out in Section 1.

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	High	• Allows staff to gain an overall view of how car parking facilities are operating; • Parking Officers will know exactly where to go to identify those who have illegally parked; • These sensors are likely to require maintenance;
O1B	Optimise Usage	High	• Identify underutilised and over utilised parking spaces, providing information that will enable B&NES Council to identify/support strategies;
O1C	Sustainable Travel	High	• Allow those looking to park to identify and be guided to the nearest possible parking space, leading to shorter trips;
O1D	Revenue Collection	High	• Occupancy data can be combined with payment data to ensure that all people parking are paying the correct amount for the time parked;
O2A	Availability of Spaces	High	• Provide the occupancy data that can be used to identify the nearest available parking space;
O2B	Access	Med	• Where restriction and control are needed such as length of stay and payments, sensors may need to be complimented by access control;
O2C	Payment Options	Med	• Sensors are more likely to combine will with cashless payment options as these will collect more data (including specific location, user account details, real parking time, etc.), than payment machines;
OTHER COMMENTS:			
• In-ground sensors are commonly used in on-street parking bays whereas sensors attached to a rail located above parking bays are often used in off-street car parking facilities; • Sensors communicate wirelessly and require nearby field communications equipment to collect data and send it to the data management software. This field communications equipment can usually be found attached to lampposts.			

Table 2-1 - Rating of Parking Bay Sensors

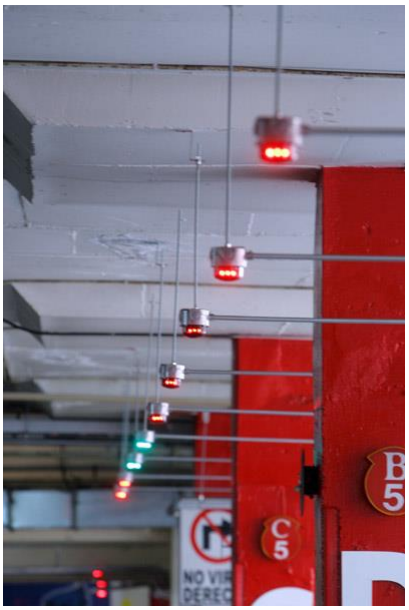


Figure 2-1 - Above Bay Sensors

Figure 2-2 – In-Ground Parking Sensors (Source: Smart Parking)

2.2.2 Automatic Number Plate Recognition (ANPR)

Automatic Number Plate Recognition is a technology widely used in many parking technology solutions (many examples can be seen in private car parks within B&NES). ANPR is a basic sensing technology that records the number plates of vehicles as they pass a camera. It can be used to determine when a vehicle arrives within a city, when a vehicle enters/exits a car park or to identify whether a parking space is occupied whilst feeding this information to a central database in real time.

Collecting number plate data would allow B&NES Council to check whether a vehicle is permitted to be at the parking facility, and also to gain data on the movement of individual end-users including the date and time of arrival and departure. ANPR allows the parking operator to streamline aspects such as entry/exit, payment and security. ANPR could help to meet the objectives we have identified in the following ways:

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	High	• Provide enforcement support by identifying illegal parking and triggering communication with parking officers; • Some ANPR systems can automatically issue Parking Charge Notices (PCN's) with very little staff resource required; • Monitoring individual parking spaces adds extra value to basic sensing technology as it increases the safety and security of parked cars;
O1B	Optimise Usage	High	• Identify underutilised and over utilised parking spaces, providing information that will enable B&NES Council to come up with strategies; • Occupancy data collected can be linked to VMS signage to improve efficiency of usage across multiple car parks;
O1C	Sustainable Travel	Med	• Monitoring individual spaces can allow shorter trip lengths to find an available space;
O1D	Revenue Collection	High	• Data collected can identify the parking time of car park users, which can then be linked with payment systems to ensure that those parking pay the correct amount for the time parked; • Can be linked to payment systems (including payment machines and cashless payment to ensure greater compliance and increased parking revenue;
O2A	Availability of Spaces	High	• Can be used at entry points to a car park, tracking overall how many cars are travelling in and out, but also to monitor individual spaces to enable occupancy data for each individual parking space within a car park;
O2B	Access	Med	• Reduces the need for barriers upon entry to a car park and therefore can open up the access to parking facilities to a wide range of end-users;
O2C	Payment Options	Med	• ANPR systems can identify a driver by their registration plate and is linked to payment machines and cashless payment, this enables the user to seamlessly pay for parking time.
OTHER COMMENTS:			
• ANPR, in general, is more effective in off-street car parking facilities. ANPR monitoring individual spaces is more likely to be used in a multi-storey car park; • ANPR may lead to the public perception of being watched or under surveillance.			

Table 2-2 - Rating of ANPR

Figure 2-3 - ANPR monitoring individual parking bays (Source: Park Assist)

Figure 2-4 - ANPR at car park entrance (Source: Horizon Parking)

2.2.3 Radio Frequency Identification tags (RFID)

Radio Frequency Identification tags can operate both with and without barriers. In both examples, a driver is given an RFID tag which they carry in their vehicle. In some examples, there is an RFID reader at the entry/exit point of the car park, which identifies the users RFID tag and allows them to enter/exit through a barrier. There are also barrier-less examples, allowing for a more streamlined experience. These operate through an in-ground sensor, which registers the driver's RFID tag and sends the driver's information to a central database. RFID can support the parking system objectives in the following ways:

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	High	• Can reduce the number of staff required by B&NES Council as they can track the movements and behaviours of specific people;
O1B	Optimise Usage	Med	• Identify underutilised and over utilised parking spaces, providing information that will enable B&NES Council to come up with strategies; • Data is only collected from those with RFID tags so this may only allow B&NES Council to gain an understanding of the usage of designated RFID car parks and users;

O1C	Sustainable Travel	Med	• Those parking with an RFID tag don't need to be identified at the point of entry, allowing free flowing traffic into the parking facility;
O1D	Revenue Collection	High	• Can be linked to an end-users account and then can allow them to be directly charged for however long they park for;
O2A	Availability of Spaces	High	• RFID tags collect occupancy data which can then be fed into VMS and end-user smartphone apps to guide users to available spaces;
O2B	Access	Med	• RFID tags offer immediate physical access to designated car parks to those who have them;
O2C	Payment Options	Med	• Payments can be made directly from an account linked to the RFID tag; • May not offer a great variety of payment options.
OTHER COMMENTS:			
• The experience of parking will be inconsistent across different user groups as those parking without an RFID tag will not be able to easily access B&NES Council parking facilities; • B&NES Council would have to manage the RFID tags, including handing them out to the right people, monitoring their use, replacing lost or damaged ones, etc.			

Table 2-3 - Rating of RFID

Figure 2-5 Smart Parking RFID Tag (source: Smart Parking)

2.2.4 Variable Message Signs

There are few examples of parking technology systems that do not feature Variable Message Signs (VMS). Signage is a crucial element of any parking facility, VMS enhances this further by providing real-time information on parking availability for bays, zones, levels and facilities. VMS allows traffic to flow towards where there are available spaces, and cuts congestion by limiting the search time for spaces. VMS helps to meet the objectives identified in Section 1 in the following ways:

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	High	• Encourages drivers to use underutilised parking spaces by showing where there are available spaces;
O1B	Optimise Usage	High	• Will help guide people parking towards underutilised car parks and spaces – leading to better overall balance of car park occupancy; • VMS can also allow B&NES Council to restrict access to certain facilities if necessary, therefore allowing greater control over their usage;

			•	VMS can help to manipulate traffic away from certain areas of car parks;
O1C	Sustainable Travel	High	•	Will shorten the trip length of anyone looking for a parking space by guiding people parking towards available spaces;
			•	Prevents congestion from forming at facilities where there are no available spaces;
O1D	Revenue Collection	Med	•	VMS could enable increased utilisation of car parks and therefore could increase revenue collected;
O2A	Availability of Spaces	High	•	Allowing drivers a better experience of parking by reducing the reliance on using a smartphone app for directions when on site;
O2B	Access	Med	•	VMS may improve access to information for those looking for parking in Bath;
O2C	Payment Options	Low	•	VMS does not tend to be linked to payment system.
OTHER COMMENTS:				
•	VMS should be applied alongside other parking technologies, as it requires parking occupancy/availability data to operate;			
•	If VMS were to communicate incorrect information it may lead to those looking for parking distrusting the system.			

Table 2-4 - Rating of VMS

Figure 2-7 - Park Assist VMS signage (source: Park Assist)

Figure 2-6 - Car Park Guidance in Torquay
(Source: Data Display)

2.2.5 Fixed Vehicle and Pedestrian Signage

As well as providing real-time VMS systems, the importance of fixed signage for both vehicles and pedestrians should not be overlooked as an element of a parking system. There are two main elements to fixed signage. The first is signage that is located around the city providing wayfinding for drivers looking for parking facilities. The second is pedestrian signage from the parking facilities to various destinations surrounding the area.

An overview of how fixed vehicle and pedestrian signage achieves the objectives set out in Section 1 is shown in Table 2-5 below:

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	Low	• It is unlikely that fixed signage will have any impact on B&NES Council staff resourcing;
O1B	Optimise Usage	Med	• Fixed signage can help to direct users to a variety of car parks;
O1C	Sustainable Travel	Med	• Those looking for parking will be less likely to get lost in the city centre and cause unnecessary congestion;
O1D	Revenue Collection	Low	• Fixed signage is unlikely to impact revenue collection;
O2A	Availability of Spaces	Med	• Allows people looking for parking to easily locate and travel to the parking facilities within the city;
O2B	Access	Med	• Information will be communicated regardless of what kind of technology a person has personal access to;
O2C	Payment Options	Med	• Fixed signage can provide information on payment options.
OTHER COMMENTS:			
• Although fixed signage is not technically a type of 'technology', it should be combined with various technologies to improve access to information for all.			

Table 2-5 - Rating of Fixed Vehicle and Pedestrian Signage

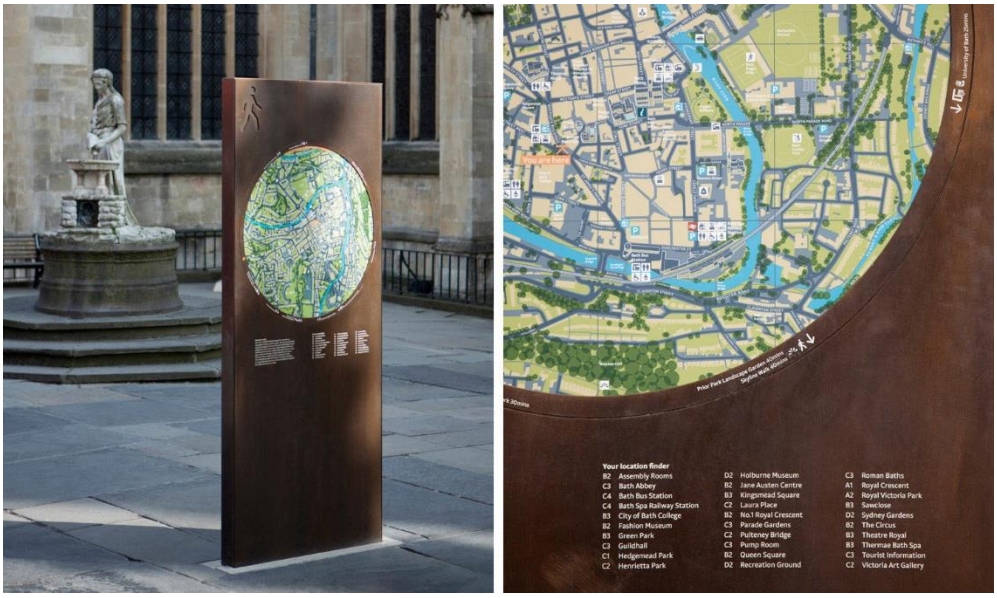


Figure 2-8 Bath Fixed Pedestrian Signage (Source: Pearson Lloyd)

2.2.6 Access Control

Entrances to car parking facilities can be managed through ticket barriers often paired with ANPR, RFID or more traditional ticketing system. When combined with ANPR technology that records the number plate and time of entry of each vehicle entering a car park, it allows the user to pay via a number of options, and then to exit the car park once the system has checked that the full payment has been received. In this way, barriers may be used to allow authorised end-users (i.e. those who have paid in full for their parking time) to access/exit a car park facility, but also to discourage unauthorised end-users from entering a car park. An overview of how access control such as barriers meet the system objectives is summarised in Table 2-6 below:

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	Med	• Automatically detect those who have parked but have not paid in full for their parking time or who should not be parking within certain facilities; • Parking technology systems often integrate with barrier technology and are often likely to count how many end-users are let through the barriers; • Could assist in minimising the need for physical infrastructure by allowing the car parking facilities to be effectively used by letting authorised end-users only into a facility;
O1B	Optimise Usage	Low	• Barriers may discourage people parking from entering a car park;
O1C	Sustainable Travel	Med	• Having to potentially queue at a parking barrier may discourage people from parking;
O1D	Revenue Collection	High	• Ensures that everyone pays for their park time;
O2A	Availability of Spaces	Med	• Certain barrier systems identify end-users by RFID and allows them a user experience similar to having a permit for parking – however this is only available to users with a RFID tag;

O2B	Access	Med	• Access is granted to those who are willing to park legally;
O2C	Payment Options	Med	• Able to connect to a wide range of payment options to allow end-users to pay for parking in a number of ways.
OTHER COMMENTS:			
• Barriers disrupt the free-flow of vehicles into parking facilities and have been known to cause congestion problems, particularly during peak times and when located next to busy roads; • Barriers are likely to cause a disruption to end-users upon entry and exit to a car parking facility.			

Table 2-6 - Rating of Access Control

2.2.7 Pre-Booking and Cashless Payment

Cashless payment solutions are commonly found in parking technology systems. A cashless payment solution allows users to pay for their parking time via an account linked to a credit or debit card. The user can access the service via a number of methods, including smartphone application, text, online, or by phone. The user commonly follows this pattern of usage: enter their location code (could be parking zone or bay ID), choose how long they want to park for, and then extend their parking time if required.

The ability to pre-pay for parking at Bath's car parking facilities is provided through the MiPermit portal, this feature allows end-users to select a location, time and duration for parking and is managed by vehicle registration number.

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	High	• Through the ability to integrate cashless payment solutions with occupancy data – B&NES Council will be able to identify zones/bays where drivers have not paid for parking and therefore will be able to minimise the number of parking enforcement staff required to police the parking facilities;
O1B	Optimise Usage	High	• Pre-booking will allow B&NES Council to monitor how busy the car parking facilities are, and whether there are any days, times or facilities where demand is particularly high or low.
O1C	Sustainable Travel	Low	• Cashless payment may increase the number of people parking by making the experience of parking better;
O1D	Revenue Collection	High	• Simplified revenue collection compared to labour intensive revenue collection from physical machines;
O2A	Availability of Spaces	Med	• If spaces are able to be pre-booked this would allow end-users to gain a better understanding of availability of spaces in advance of traveling;
O2B	Access	Med	• Pre-paying for parking allows the parker to access selected parking facilities without having to worry about paying; • Improves access to B&NES Council parking facilities by enabling parking with no need to physically walk to a payment machine or to carry cash;
O2C	Payment Options	Med	• Present a range of payment options to users – Bath's MiPermit portal users can pay by smartphone application, text, online, or by phone call.
OTHER COMMENTS:			
• B&NES Council already have a cashless payment system in the form of MiPermit.			

Table 2-7 - Rating of Pre-Booking and Cashless Payment

2.2.8 Payment Machines

As the parking technology market develops, products are beginning to shift from the form of hardware to software, and as a result many private and public parking facility operators are moving away from physical payment machines. Some of the advantages and disadvantages commonly associated with physical payment machines are listed below:

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	Low	• There is a large cost associated with physical payment machines, including cash collection and repairs;
O1B	Optimise Usage	Low	• Payment machines are unlikely to encourage optimum usage of car parks;
O1C	Sustainable Travel	Med	• Payment machines may deter people from parking (and therefore driving) and therefore may encourage people to use sustainable transport modes;
O1D	Revenue Collection	Low	• If a car park's payment system runs purely on physical payment machines these only enable people with cash on them to pay for parking; • The cost associated with collecting revenue from payment machines is relatively expensive compared to cashless solutions;
O2A	Availability of Spaces	High	• Physical payment machines can be used by everyone as they do not depend on having access to a special type of technology;
O2B	Access	Low	• Payment machines are unlikely to improve physical access and access to information for car parks;
O2C	Payment Options	Low	• Offering only payment machines is unlikely to provide enough diversity for the range of people using car parks.
OTHER COMMENTS:			
• They are often targeted by vandals and thieves even in the event that they only accepts credit/debit cards and do not collect cash; • Payment machines are not particularly aesthetically pleasing; • Manufacturers constantly bring out software upgrades and charge a lot of money for them.			

Table 2-8 - Rating of Payment Machines

2.2.9 Data Platforms

2.2.9.1 Data Management Software

The central component of a parking technology system is the management software. This consists of a back office database that collects data from connected components of the parking technology system and provides front-end analytics tools to enable the car park owner/operator to achieve the maximum effective use of the car park. The parking management software would enable B&NES Council and the end-users to benefit in a number of ways, including:

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	High	• All occupancy data available is sent to central parking management software, it is able to support B&NES Council in the detection and enforcement of illegal parking and disperse this information to parking officers; • Parking management software is able to send alerts to parking

			enforcement officers; • The parking management software has a user interface that allows B&NES Council to analyse and manage the parking stock; • Information and data on membership accounts can be stored within this central location and is easily accessed by the parking operators;
O1B	Optimise Usage	High	• Allows B&NES Council to manage the parking network in real-time, which could be used to make underutilised spaces more attractive or over utilised spaces less attractive to people parking;
O1C	Sustainable Travel	Med	• Reduces congestion by using occupancy data to allow the identification of available spaces through VMS and smartphone applications;
O1D	Revenue Collection	High	• Provides a window to manage the billing and revenue system;
O2A	Availability of Spaces	High	• Collates all occupancy data and feeds this into VMS and smartphone applications to guide end-users to available spaces;
O2B	Access	Med	• Can be used to control who accesses certain car parks and also can be used to update information on web page or smartphone app;
O2C	Payment Options	Med	• Can be used to collate and view all payments/transactions made from a range of payment options.
OTHER COMMENTS:			
• Parking management software is able to send any required alerts and relevant information to end-users.			

Table 2-9 - Rating of Data Management Software

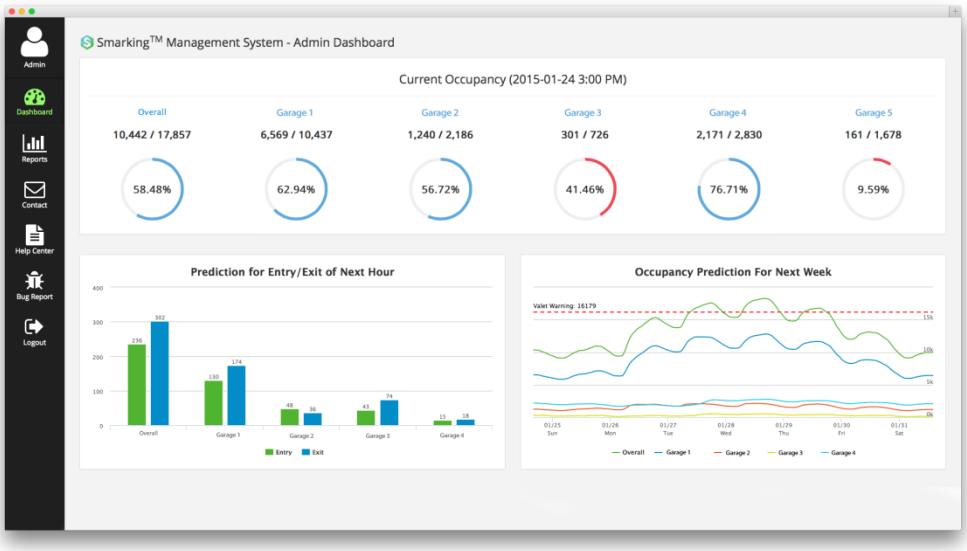


Figure 2-9 Parking Management Software (source: Smarking)

2.2.9.2 Data User Platform

Smartphone applications tend to tap into a source of information provided by a parking owner/operator through an Application Programming Interface, allowing a variation of offers in terms of functionality and benefits. This means that other parking technologies provide smartphone applications with data, including sensors which monitor availability and send data to central databases. This allows smartphone applications to tap into a real-time data flow. Other features and benefits of smartphone applications include:

CODE	LABEL	RATING	COMMENTS
O1A	Minimise Resourcing	High	• Smartphone applications can be used to allow parking enforcement officers to identify those who are illegally parked;
O1B	Optimise Usage	High	• A smartphone application may allow end-users to identify exactly where there is an available space that may not otherwise be visible;
O1C	Sustainable Travel	Med	• The ease of using a smartphone application for any parking in the B&NES area could increase the number of people travelling into urban areas by car; • If the smartphone application shows that there are limited/no spaces left in car parks then this may deter people from travelling into urban areas by car;
O1D	Revenue Collection	High	• Smartphone applications can be used to allow users to pay for their parking; • Any cashless payments made via an app are likely to have a small cost associated with them for B&NES Council, comparative to payment machines;
O2A	Availability of Spaces	High	• The user experience is enhanced from the beginning of their journey until they exit the car park; • Directions to an available space are provided, allowing a free flow of traffic and ease of congestion, this also allows drivers to find spaces that may be harder to initially identify.
O2B	Access	Med	• Access to a range of B&NES Council parking facilities – end-users are able to set up and control their own accounts and membership profiles;
O2C	Payment Options	Med	• A range of payment options available – a variety of payment functions are available including pay and park and pre-loaded e-wallets;
OTHER COMMENTS:			
• There are a wide variety of app providers that can adapt to B&NES Council branding and also then allow end-users to access parking information for other areas too.			

Table 2-10 - Rating of Data User Platform

3 Summary Assessment of Alternative Parking Management Technologies

3.1 Technology Rating Matrix

The matrix in this section has been created to show at a glance which individual parking technologies meet the key system objectives set out earlier in the report. Each technology has been explained in further detail in the previous section. This matrix has been used to make recommendations as to the type of technologies that B&NES Council could implement in order to successfully achieve the key system objectives.

CODE	LABEL	Parking Bay Sensors	ANPR	RFID	VMS	Fixed Vehicle and Pedestrian Signage	Access Control	Pre-Booking and Cashless Payment	Payment Machines	Data Management Software	Data User Platform
O1A	**Minimise Resourcing**	High	High	High	High	Low	Med	High	Low	High	High
O1B	**Optimise Usage**	High	High	Med	High	Med	Low	High	Low	High	High
O1C	**Sustainable Travel**	High	Med	Med	High	Med	Med	Low	Med	Med	Med
O1D	**Revenue Collection**	High	High	High	Med	Low	High	High	Low	High	High
O2A	**Availability of Spaces**	High	High	High	High	Med	Med	Med	High	High	High
O2B	**Access**	Med	Med	Med	Med	Med	Med	Med	Low	Med	Med
O2C	**Payment Options**	Med	Med	Med	Low	Med	Med	Med	Low	Med	Med
OVERALL		HIGH	HIGH	MED-HIGH	MED-HIGH	MED	LOW	MED-HIGH	LOW-MED	HIGH	HIGH

Table 3-1 - Technology Rating Matrix

4 Recommendations

This note has explored alternative technologies that could be applied across a range of B&NES Council's parking facilities to support the parking strategy, to minimise resourcing of any management and physical infrastructure associated with parking and to ensure that traffic is able to move efficiently around the city with minimal impact.

4.1 Overview of Key Issues Identified

Following our assessment in Section 3 which compares the system objectives with the potential parking technologies, it is recommended that B&NES Council consider the procurement of a holistic parking technology system, which as previously detailed consists of a number of components that work together to form a full parking ecosystem:

- Occupancy detection system tracks the occupancy of individual parking spaces and entire parking facilities;
- Payment systems process transactions and then send data to data management software;
- Occupancy data and payment data are sent to data management software and collated, then this information is sent to:
  - Variable Message Signs;
  - Data user platform for both parking officers and end-users;

A recommendation for element of the proposed system is set out in more detail below.

4.2 Occupancy Detection System

Recommended Technology (On-Street): In-ground sensors

The type of occupancy detection system recommended for on-street parking across B&NES are in-ground sensors that simply detect whether a parking space is occupied. These sensors would sit in the ground within each parking bay and are wireless with long-life batteries that are likely to last 5+ years;

These sensors will detect the real-time availability of each parking space that is monitored by a sensor. These sensors would operate well as an occupancy detection system for on-street parking where there is no dedicated entry or entrance point to the parking.

Recommended Technology (Off-Street): ANPR with above-bay camera sensors for off-street car parks

It is recommended that ANPR is located at all off-street car park entrances, allowing B&NES Council to track the movements of individual end-users which may provide additional data over and above occupancy of the car park.

To complement ANPR at car park entrances, at multi-storey car parks, above-bay camera sensors are recommended to add an additional layer of data within the actual car park. These camera sensors act as mini ANPR cameras, but also have a simple occupancy detection system identifying when each space is available, as well as acting as mini security cameras to offer additional safety to parked vehicles. These above-bay sensors often feature a light that indicates when a space is available to assist drivers with locating the nearest available space. These sensors are wired and tend to be attached to a railing on the ceiling of a multi-storey car park.

4.3 Payment System

Recommended Technology: Expand MiPermit to cater for all cashless payment transaction.

B&NES Council already provide a good variation of payment options for people parking throughout the area. It is recommended that B&NES Council review these options and consider streamlining them. For example, perhaps the use of MiPermit could be encouraged for anyone parking anywhere in Bath, including those who are just making a one off trip. The available options should be streamlined by B&NES Council until there is no longer a need to have payment machines.

It is not recommended that B&NES Council introduce pre-booking for parking across the area. This is largely because of the assumed number of 'one-off' type trips made to the area by visitors, meaning that there is very little chance of many people knowing that parking should be pre-booked before arriving. Pre-booking parking is, in most cases, likely to lead to an improved user experience for those looking to park, however in the case of the B&NES area it may have the opposite effect due to the nature of trips made. It is also unlikely that the Council could persuade private car park operators to adopt pre-booking as the car parks throughout the area tend to fill up very easily.

B&NES Council may wish to undertake a review of car parks across the area to see whether there are any specific car parks where pre-booking would lead to significant benefits to the end-users.

4.4 Data Management Software

Recommended Technology: Introduce a data collection software that enables B&NES Council to manage the entire parking stock, introduce a smartphone application for end-users and enable parking officers to access occupancy data through an application.

All information collected by the occupancy detection system should be collated into a single data collection software that is owned and accessed by B&NES Council. This system will include an interface that will allow B&NES Council to view how the car parking spaces across the B&NES area are operating collectively and individually, therefore allowing B&NES Council to identify under or over utilised car parks. Any new data collection software that is adopted by B&NES Council should be able to also collate data from the current MiPermit system that is used to provide cashless payment for parking.

4.5 VMS

Recommended Technology: Increase the quantity of VMS and diversify its role.

Increase the quantity of VMS and diversify its role so that it becomes a core part of the parking technology system, from the outer city where people travelling into Bath by car are guided along the best routes to access parking, to within the city centre where traffic is guided to car parks based around the city with available spaces, to within a car park itself where signs or lighting are used to show which level/direction there are available parking spaces. VMS systems should, where possible, include information from privately operated car parks as well as B&NES Council's own car parks.

Ideally, the VMS system introduced will allow B&NES Council to programme in routes that they wish for people to use to travel to various parking facilities across the city.

Increasing the quantity of VMS where possible is important within the B&NES area as there is likely to be a high number of visitors looking to park, particularly in Bath, and therefore access to smartphone apps for parking may not be common.

Fixed signage should also be provided/enhanced that both guides those looking for parking to car parking facilities across the city and also for pedestrians to navigate the attractions and destinations around the city.

4.6 Data User Platform

It is recommended that B&NES Council procure the following data user software:

- A smartphone app and website for those looking for parking that contains all occupancy data allowing end-users to efficiently locate available spaces;
- An application for parking enforcement officers that allows them to see where people have parked illegally – including those who have parked and have not paid in full for parking.

Both of these data user software should provide two way communications between the end-user and B&NES Council where necessary

5 Suggested Roadmap

This note has recommended a number of parking technology elements that could form the parking technology system for B&NES Council parking facilities. The information set out within this report, including the objectives and requirements for the system, can help B&NES Council to identify the types of technology and the companies that they may wish to engage with to procure each parking technology type.

A possible way forward that the Council may wish to consider is set out below and it is recommended that these are undertaken in parallel with a similar set of actions being taken on the coach parking strategy.

Stage 1

Action 1: Undertake Signage Review (vehicular and pedestrian) – this should be produced in the form of a report and content will include the identification of any gaps in the existing signage provision and will also ensure that a strategic and consistent approach has been taken across all signage provided to ensure an optimum user experience for end-users.

This review should result in the identification of a range of quick wins and longer term strategies for signage relating to parking across the B&NES area.

Action 2: Develop a detailed specification for alternative parking management systems using on-street parking sensors and ANPR – this should be undertaken by B&NES Council, with input from industry specialists/vendors identified through the Market Study (summarised in the Appendix). This specification will include any preferred requirements and functions for the desired on-street technologies, parking sensors and ANPR.

This stage should result in an RFP which details the entire parking management system required, and will include each of the system elements recommended within this report. The next stage is to issue this to selected vendors identified through the Market Study (summarised in Appendixes A and B) in order to procure a vendor to deliver a parking management system.

Stage 2

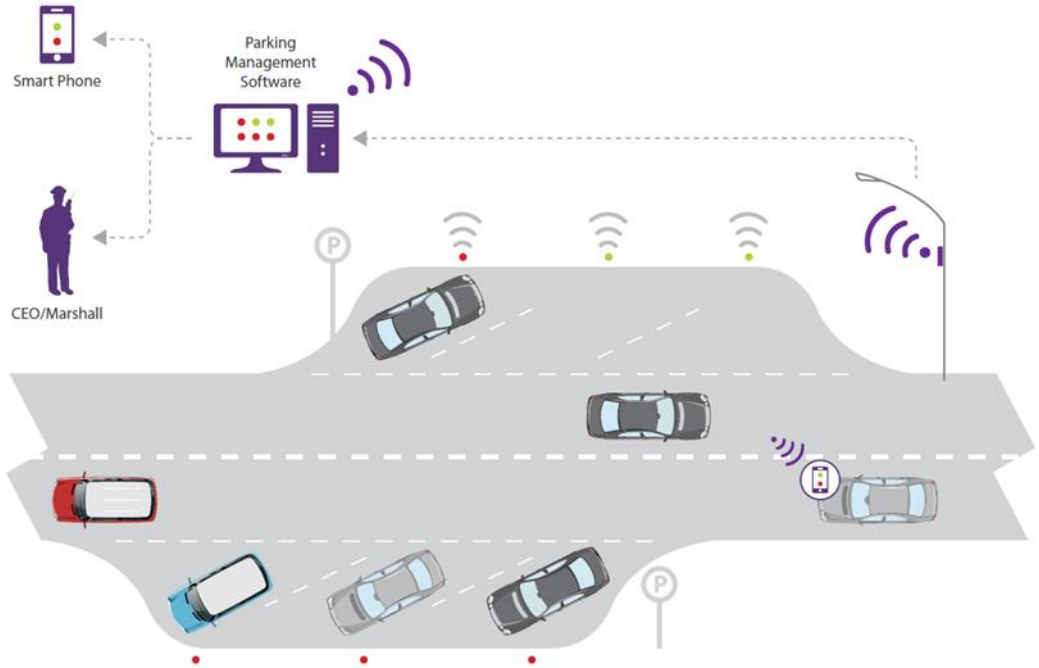
Action 3: Implement quick win signage improvements – this follows on from Action 1 and involves B&NES Council implementing any signage improvements that were identified in the Signage Review as being quick wins. The identification of someone within B&NES Council who will have overall responsibility for the implementation of quick wins is recommended to complete this stage.

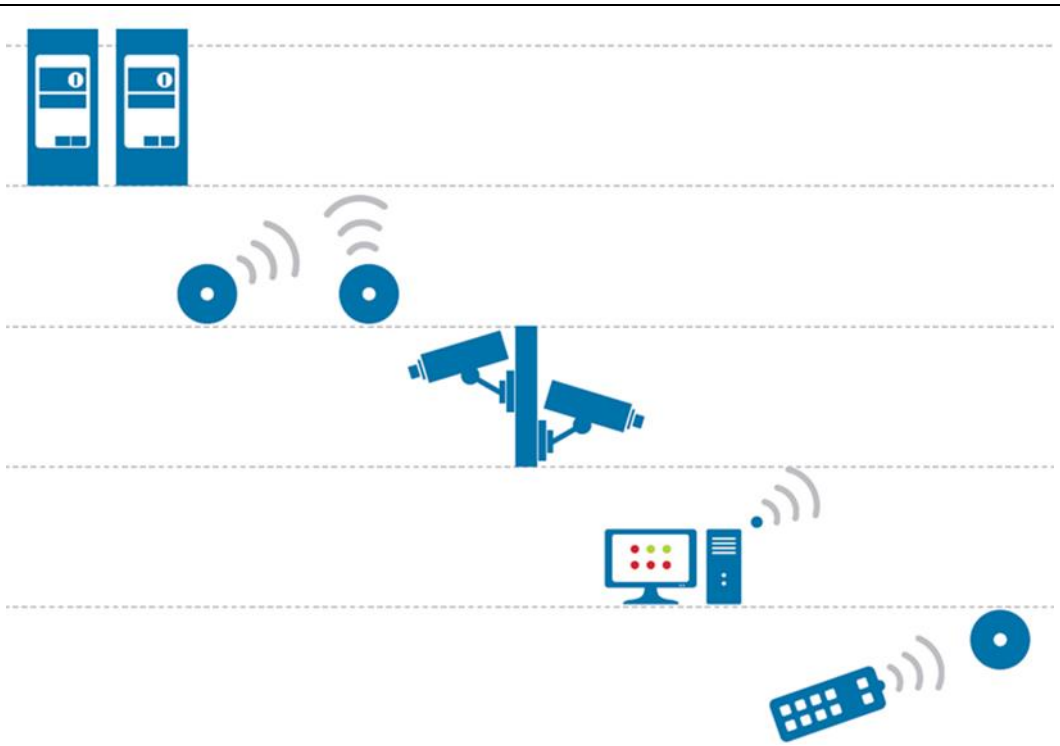
Stage 3

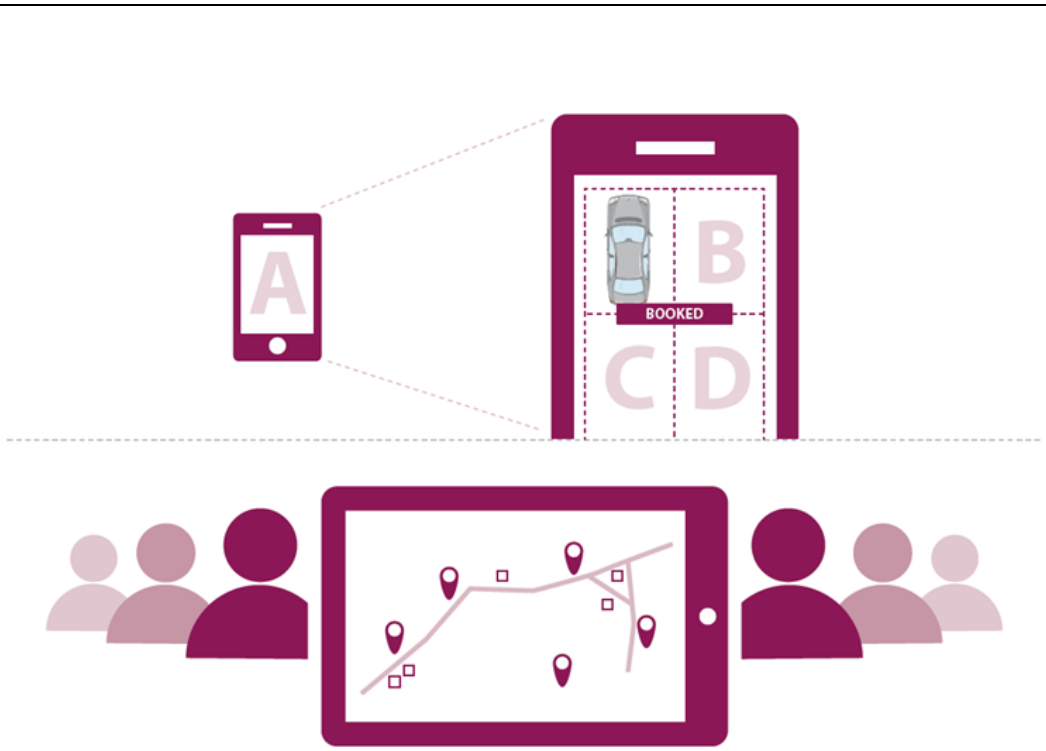
Action 4: Implement new parking management system – by this stage, B&NES Council will have procured a parking management system and are now responsible for its successful implementation. The identification of someone within B&NES Council who will have overall responsibility for the implementation of the parking management system is recommended to complete this stage.

Action 5: Implement remaining elements of signage - this follows on from Action 1 and Action 4 and involves B&NES Council implementing any signage improvements that were identified in the Signage Review as being quick wins. The identification of someone within B&NES Council who will have overall responsibility for the implementation of quick wins is recommended to complete this stage.

Appendix A Market Scan Results

Holistic Parking Technology Solution	
Companies	SMART PARKING SIEMENS PARK ASSIST REALLY SMART PARKING STREETLINE CONNECTING THE REAL WORLD WORLD SENSING xerox
Graphic	
Description	These companies offer parking technology solutions as a complete service. They focus on creating parking 'ecosystems' creating a seamless user experience. Holistic Parking Solutions can often be found forming close relationships with city governments in order to deliver city parking solutions. Benefits of this technology type: • Integrated solution; • Client owns and manages data; • Consistent data available to all users.

Singular Parking Technology Solution	
Companies	parkare GROUP urbiotica THE CITY OPERATING SYSTEM SIEMENS PARKEON nedap technology that matters VivoPark
Graphic	
Description	These companies offer a range of parking technologies solutions, but they each tend to specialise in one particular technology. Parkare/Parkeon specialise in parking meters Nedap and Urbiotica specialise in sensor technology; Siemens Car Finder and VivoPark's Tesco parking system are great examples of ANPR technology; Smarking provides market leading data analytics software; GreenParking have developed a remote control space reservation unit. Benefits of this technology type: • Extensive experience in consortiums; • Often offer unique speciality products; Products are often designed to integrate with other products.

Smartphone Applications	
Companies	ParkWhiz Click here. Park anywhere. SpotHero APPARCAR SMART PARKING SOLUTIONS PassportParking appyparking JustPark
Graphic	
Description	A large number of parking based smartphone applications have emerged in recent years, many of them proving to be a huge success. Smartphone applications for parking traditionally follow the process of: find a space; book a space; and check in and park.

HOLISTIC PARKING TECHNOLOGY SOLUTION	COMPANY NAME	PRODUCT NAME	PRODUCT DESCRIPTION
	Smart Parking (partnered with Viarium)	SmartPark	Combination of parking technology products and services designed for both on and off-street parking
	Streetline	Real-time mobile applications: Parker, ParkerMap. Applications, data and analytics: ParkSight, ParkEdge, Guided Enforcement	Combination of parking technologies that create a parking 'ecosystem' 1. sensors detect arrival and departure in real time 2. Motorist guided to space 3. Motorist parks 4. pays by phone, timer activated/pays by meter 5. officer guided to unpaid cars 6. Staff receives analytics for decision making
	Worldsensing	Fastprk	Worldsensing's Fastprk solution uses innovative sensor and radio technologies to detect the presence of vacant parking places, both indoors or outdoors. This information is made available in real-time to those in need of it, either via smart phones (using free-of-charge smart apps) or displays along the road.
	Park Assist	M4 Park Assist Camera System	The M4 Camera Sensor offers the ability to sense, identify and count vehicles per individual garage parking space. Configured with one or two CMOS digital cameras, sensors monitor up to four parking spaces simultaneously. Camera images are continuously processed by the onboard computer to detect parking space occupancy changes using proprietary image processing software. For surveillance purposes, the cameras' output can be streamed over the network.
	Siemens	Siemens Integrated Smart Parking Solution	Sensors allow a picture of where available spaces are and length occupied Highlights improper use of non-parking areas Routing and enforcing applications and city dashboards - info accessible by various audiences Multiple complimentary applications can be linked on a single platform
	Xerox	Smart Parking Solutions	Xerox offer a wide variety of parking products based around these four components: • Customer Experience • Street Operations • System Support & Analytics • Compliance

	Skidata	Skidata Parking Management	Barriers and columns, automated payment machines, reservations and booking, reports and statistics, expert services, points of sale and validation, tickets, operating and monitoring.

SINGULAR PARKING TECHNOLOGIES	COMPANY NAME	PRODUCT NAME	PRODUCT DESCRIPTION
	Parkare/Parkeon	Madrid Smart Parking Meters	Madrid City has installed parking meters that charge users according to how sustainable their vehicle is.
	Nedap	TRANSIT, UPASS, ANPR, SENSIT	Nedap offer a variety of technologies including wireless parking sensors, automatic number plate recognition, RFID technology that identifies vehicles and people.
	Urbiotica	U-Spot, U-Flow	U-Spot: wireless parking sensor that detects parking space occupancy; U-Flow: smart traffic measurement sensor; U-Admin: software allowing control and analysis of sensors.
	GreenParking	Flinkpark	Flinkpark is a remote control space reservation unit. The parking space user is able to use a remote control to access the space. Solar panelled charging Flinkparks are available.
	Siemens	Car Finder	Integrates CCTV, digital recording, advanced automatic number plate technology, bay monitoring, barrier control and customer information kiosks to assist motorists in finding parking spaces and locating their vehicles on their return.
	VivoPark/Metric	Streatham Tesco	Customers entering the car park would be registered by ANPR cameras, and following their shop would be given a voucher by the cashier. At the VivoPark terminal, customers simply input their car registration, select their vehicle from images on screen and scan the voucher to validate their parking. This simple process should take no longer than 60 seconds.
	Smarking	Smarking database	Uses predictive analysis to improve parking experience; Optimises staffing and reduces operational cost; Foresees future demand and maximises utilisation of parking assets; Shares availability information with end-users.

	Skidata	Skidata Parking Management	Barriers and columns, automated payment machines, reservations and booking, reports and statistics, expert services, points of sale and validation, tickets, operating and monitoring.

	COMPANY NAME	PRODUCT NAME	PRODUCT DESCRIPTION
SMARTPHONE APPLICATIONS	**AppyParking**	AppyParking	AppyParking has collated on and off-street parking information across London and 11 of the UK's biggest cities. Free app and website allows you to see when and where you can park and at what time of day, including the following features: • Real-time availability; • Different types of spaces for different types of drivers (unsure whether coaches are currently included) • Helps user find the nearest and cheapest spot. • Details of controlled parking times.
	ParkNow	Mobile booking platform	1. Find a parking garage 2. book your space 3. check in and park
	Pango	Pango+App	Mobile payment service available for both parking lots and on-street parking
	PassportParking	Mobile Pay Private Label Mobile Pay Operations Management	Allows users to use mobile (app, website, phone call, text) to pay, extend parking session, receive notifications of expiry, view and print reciepts online; Allows client to use own branding, also gives client complete control over architecture, flow of the app, or the messaging; Back office tool provides complete control and analytics of mobile payments; Cloud based application; Reporting and management suite.

	ParkWhiz	ParkWhiz App	User can search and compare parking spaces User can book parking space in one 'tap' paying by credit card, apple pay, or Google Wallet User gets directions to parking spot and walking directions to destination
	JustPark	JustPark App	User can search and compare parking spaces User can book parking space in one 'tap' paying by credit card, apple pay, or Google Wallet User gets directrions to parking spot and walking directions to destination

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