1 Overview

1.1 The 2012 Olympics aims to be a “Green Olympics”, with most spectators travelling to the site by public transport. A key travel requirement for the London 2012 games is therefore to deliver accessible journey plans to support the Games Network of Accessible Transport (GNAT). To support this Transport Direct is investigating the necessary changes to the UK data standards to support the modelling of venues and points of interest as well as stations so as to support better journey planning. This will allow consideration of paths and times to reach individual venues in the Olympic Park and other Olympic sites.

1.2 The 2012 Olympic Park is being built in Stratford in Northeast London, E15. The park contains a number of individual venues for different events and is next to Stratford, Stratford International and West Ham stations (*Figure* 1).

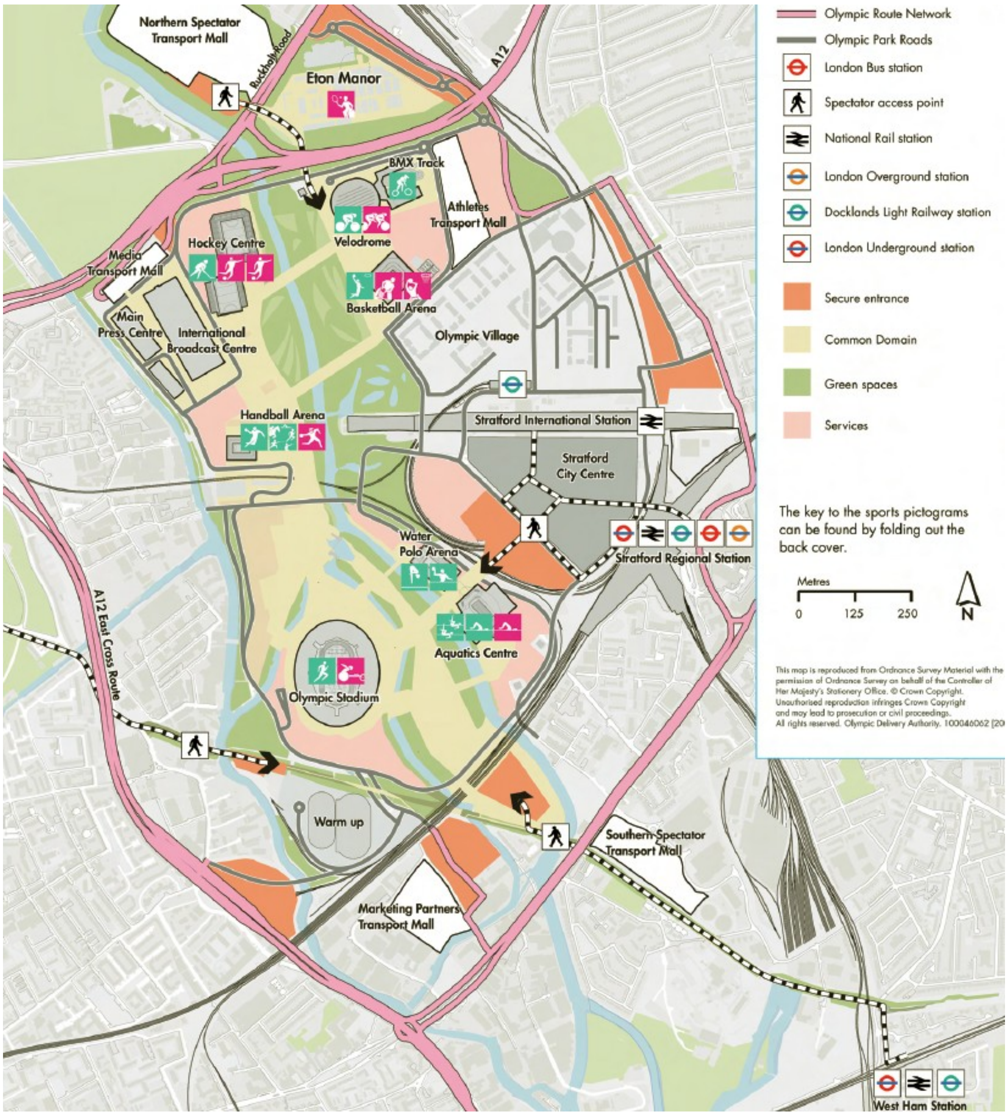


Figure 1 – 2012 Olympic Park (http://www.london2012.com/)

1.3 The objective is to make it as easy as possible for spectators to find the best journey plan to get to their event on time, and to return home afterwards. A much better result can be achieved if certain data about the venue site is available to journey planners.

1.4 This paper considers how an Olympic venue or other point of interest could be represented in a common ‘site model’ to support advanced journey planning. The current UK NaPTAN stop model represents stops and stations as access points for journey planning. The proposed new site model would provide equivalent elements to represent the parts of a destination point of interest (such as Olympic venues), and furthermore be augmented with additional concepts that enable enhanced journey planning – including accessibility and access times. The NeTEx / IFOPT site model envisions a standardised, detailed representation of complex locations that can be used by many different applications to provide guidance and assistance to users.

1.5 The approach would also use a systematic method to allocate identifiers for the venues and their entrances that is compatible with the existing NaPTAN system.

1.6 The 2012 Olympic Park has been chosen as a discussion site because it is sufficiently complex to illustrate many of the key aspects of travel to a large venue with multiple destinations, several potential transport points and constrained routing within it. As Figure 1 shows, different entrances are optimal for different venues within the site, and the distances – e.g. about 3km as the crow flies from West Ham to the northern entrance and about 1.5km from side to side – are large enough to be material for journey planning as far as time and choice of gateway station. The topology of the site itself is quite constrained: for example to get to the BMX Track from the Stratford Entrance involves going round three sides of a square and crossing two bridges.

1.7 It may be helpful to outline briefly how the data captured by the model would improve a user’s experience of journey planning to Olympic events. A useful illustration of the simplicity of an “event oriented” planner can be seen in Figure 2, which shows the input screen for a basic “match journey planner” for Newcastle United. The user just has to select a match and a stand; this allows the journey planner to compute a journey to arrive at the appropriate time at the Newcastle United home ground. (It isn’t clear whether it optimizes the gateway station for the stand entrance).

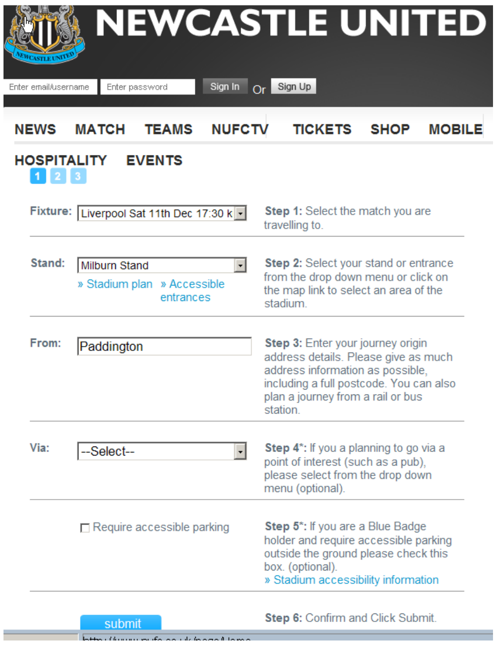


Figure 2 – Match Journey Planner input screen –

(www.nufc.co.uk)

1.8 For the Olympics, a user would be able to input either the actual Olympic event for which they have tickets, or just the Olympic venue to which they wish to travel, along with their origin point and any accessibility needs. The journey planner would be able to select the best gateway station and entrance for its results. Furthermore, the journey plan would allow sufficient time for security check processes under the expected conditions at the time of travel of the venue access leg.

1.9 Without venue level planning model, journey planning is both more complex for the user – they must relate the park to the venues and gateway stations themselves and work out how much time to leave – and less accurate; for example the user will not necessarily be aware of the right amount for time to leave for the park access leg, especially if there are additional security processes.

1.10 The 2012 Olympic Park example does not however cover journey planning access to very large buildings, since only Olympic venues – and not their internals – are modelled. To show how the NeTEX / IFOPT model can help navigation to large buildings, an additional example for Wembley is also considered at the end of the paper.

1.11 This paper on venues can be regarded as a side paper to a longer and more detailed paper '*IA09301g Accessible Journey Planning - Wimbledon Station*' (DfT Transport Direct Sept 2010) which discusses the detailed modelling of transport interchanges using Wimbledon as an example. Some common aspects of the model are not discussed in this paper.

1.12 This paper assumes a basic understanding of the NaPTAN data model and the IFOPT model. See '*NaPTAN & NPTG Schema Guide v2.4'* Transport Direct 2010 & 'IFOPT: *Identification of Fixed Objects in Public Transport'* CEN 2008. Note that the IFOPT model has been updated in the NeTEx revision.

1.13 It should be stressed that for pragmatic reasons the Olympic work focuses on the minimum representation needed to meet the ODA objectives. However the same model can be populated in detail to describe the internals of complex venues and additional accessibility features. The establishment of a basic set of data as part of the Olympic program of works will create a framework data set built over the existing NaPTAN data set that that can be extended over time for other venues and to include additional navigation data. This will enable a rich set of additional applications and widespread coverage of many different types of point of interest.

1.14 All graphics and maps are copyright of the indicated sources.

2 2012 Olympic Park Structure

2.1 The 2012 Olympic Park is a complex site with a number of distinct venues nested within a larger site. See *Figure* 1 above. Other clusters of venues are found at each of the Olympic zones in London (Figure 3), some sharing a security perimeter, others stand alone.

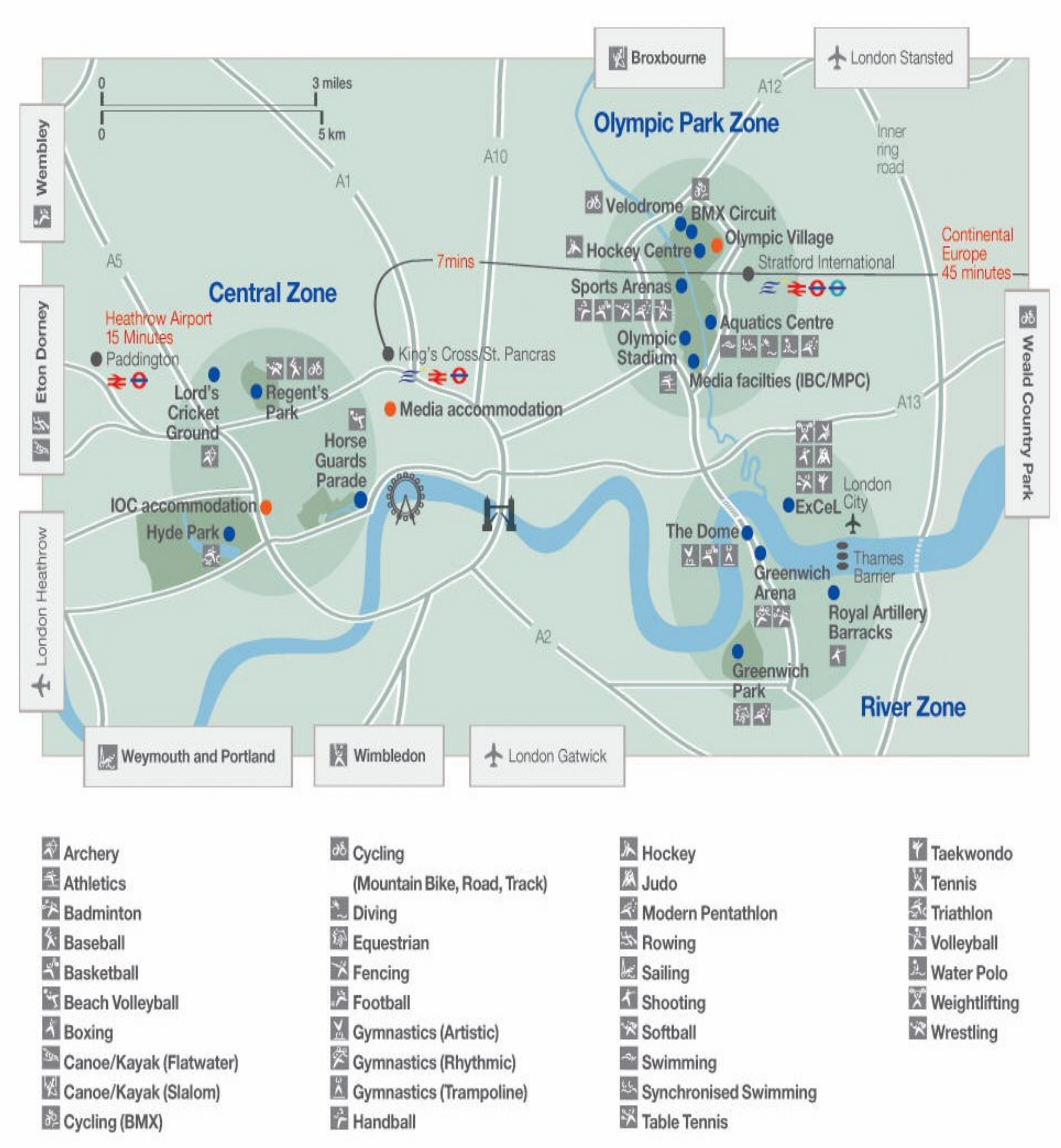
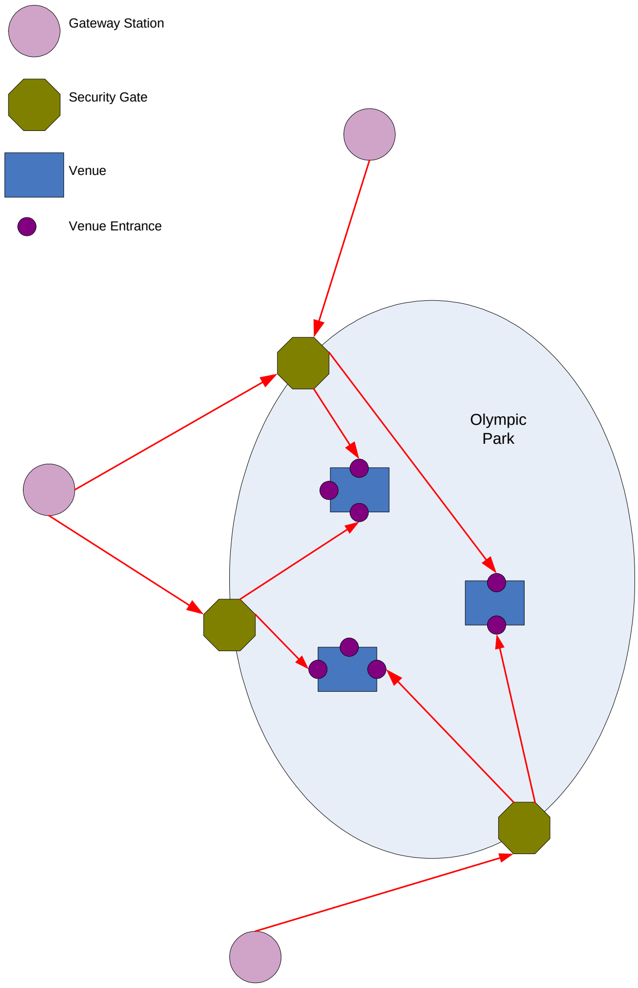


Figure 3 – Other London Venues (london2012 transport plan)

2.2 Olympic events require a stringent security regime and all public access to the park is though controlled entrances with security checking at managed points. This is shown schematically in *Figure 4*, which distinguishes between an overall park, the venues within it, the security gates and the entrances to the venues.

Figure 4 – Linking gateway stations to gates and venues (Transport Direct)



2.3 For example *Figure* 1 indicates that the 2012 Olympic Park will have three principle spectator access entrances at Stratford centre, and on the Northern, and Southern sides. An additional Eastern entrance connects with the warm up area and the Southern entrance. Different gateway stations or stops will be convenient for each entrance.

2.4 Each of the venues with the Park may be a complex object in its own right with multiple entrances, spectator areas, internal levels, etc. For example *Figure 5* shows the planned aquatics centre which has separate entrances at either end and two 50 metre swimming pools and a 25 metre diving pool within its confines.

Figure 5 Olympic Aquatics centre (www.london2012.com/)

2.5 *Figure 6* shows a cutaway of the main 2012 Olympic stadium showing a radial set of entrances and a number of different spectator levels. In this case it may be better to consider that there is no single entrance but rather that the building can be entered from any side. Similarly it is not clear that the Warm-up Area has well defined entrances.

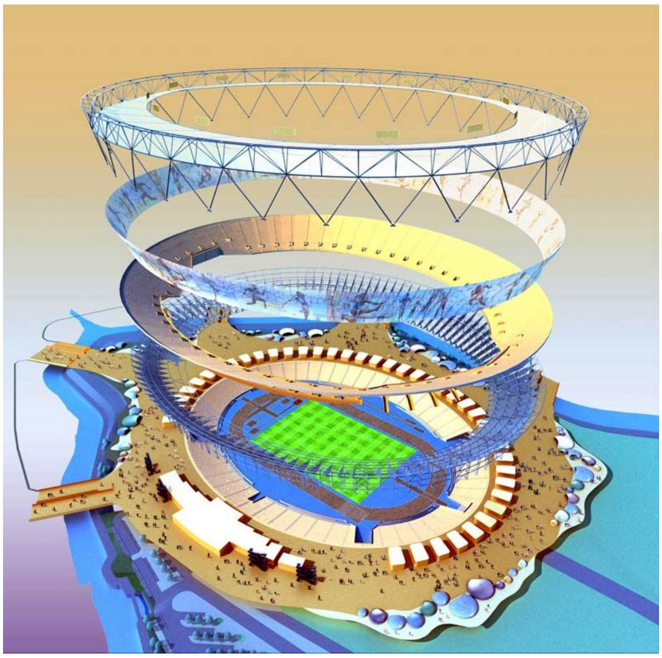


Figure 6 – Olympic Stadium Schematic - (www.e-architects.com)

2.6 *Figure 7* shows the venues from *Figure* 1 arranged schematically as a set of named points and their entrances positioned at their relative spatial positions. (NB This diagram, including the actual number of entrances is intended only as an approximate illustration, not a precise representation of the 2012 Olympic Park site–for example, it indicates that in principle that there may be multiple designated entrances to each venue, but the actual number and placing of entrances is incorrect). The venues sit within the overall Olympic Park (green rings) which has controlled entrances with security processes (orange stars). Each of the triangles indicates the element is a point that might be identified with NaPTAN Identifier to locate it to a journey planner (Green triangles are entrance points, red triangles are areas used to represent the venue as a whole).

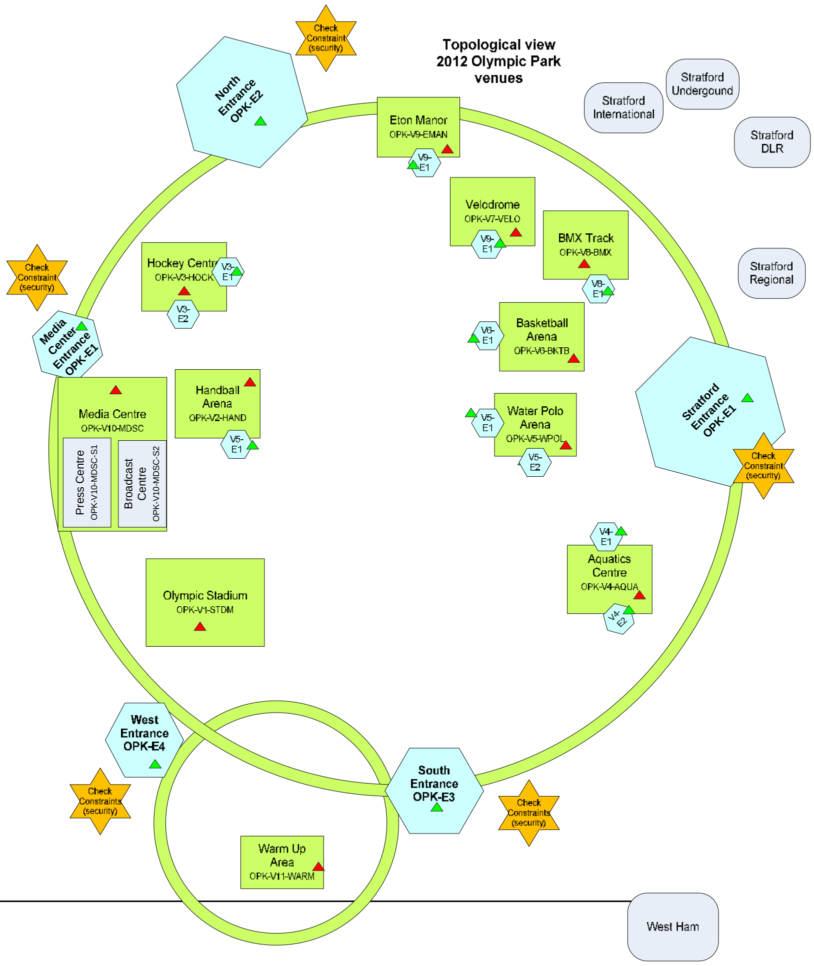


Figure 7 – 2012 Olympic Park Venues

2.7 *Figure 8* shows many of the possible point to point transfers between the entrances and venues in the 2012 Olympic Park that spectators are likely to want to make as part of a journey plan to reach a specific venue for which they have tickets. There are many combinations of park entrance and venue, with differing distances and transit times. At times of congestion, for example when the main stadium is filling or emptying, some routes may take even longer because of congestion.

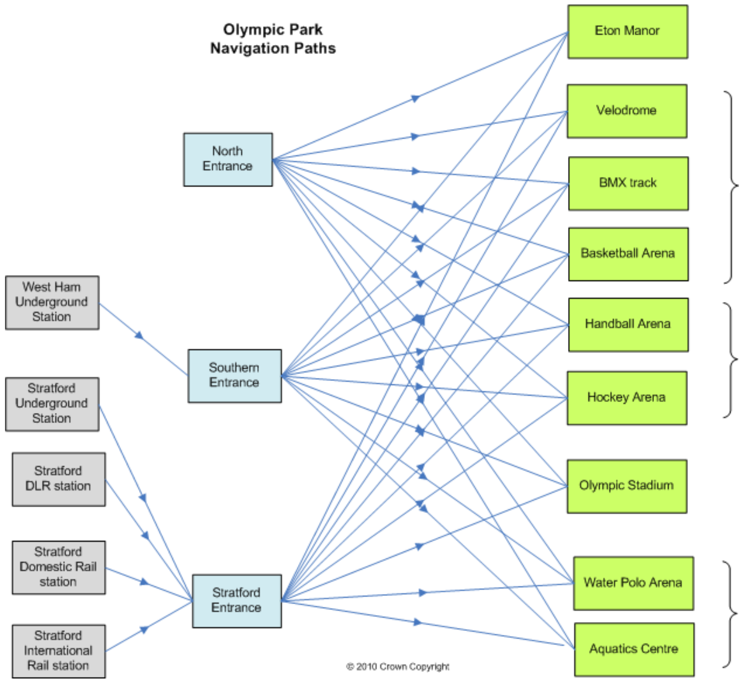
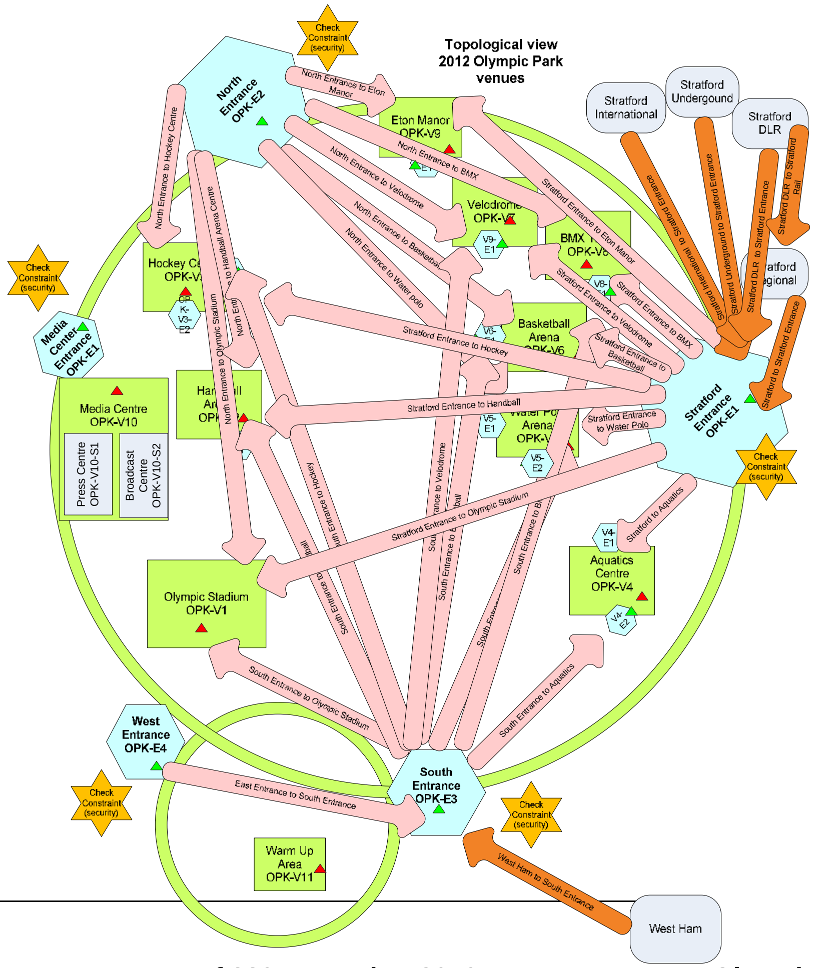


Figure 8 – Point to Point Transfers

2.8 *Figure 9* shows the transfers as summary navigation paths from, overlaid on the *Figure 7* schematic. There is an orange arrow for each station to each park entrance and a pink arrow for each entrance to each venue. Thus for every line in *Figure 8* a simple straight arrow is shown in Figure 9. This can be regarded as the minimal representation to support the Olympic Requirements; every venue and entrance is a NaPTAN point and a simple matrix of transfer times and delay times can describe the additional journey planning legs.

Figure 9 – 2012 Olympic Park: main Navigation paths



2.9 Although *Figure 9* shows simple entrance to venue transitions as simple straight arrows, in reality the 2012 Olympic Park site is very much constrained by the connectivity of its paths and bridges – the pink arrows are not really straight! Furthermore, the more venues there are on the site the more entrance/venue combinations there are

2.10 *Figure 10* shows how the 2012 Olympic Park site might be modelled at a simple topological level of detail, with the ways between the entrances, junctions and bridges and subways represented as path links so that a more accurate detailed step by step journey plan could be provided between any two points. Links can also describe the external routes from gateways stations and stops (these are grossly simplified in *Figure 9*).

2.11 As *Figure 9* shows, there may be distinct paths that are preferable to reach a given entrance of a venue. For example to get from the South entrance to the Water Polo Arena, different routes are needed to reach each of the two entrances. Using the more detailed model of *Figure 10* it is possible to compute all of the Navigation Paths shown in *Figure 9* from the detailed path links. For a large site this is a simpler and more accurate approach.

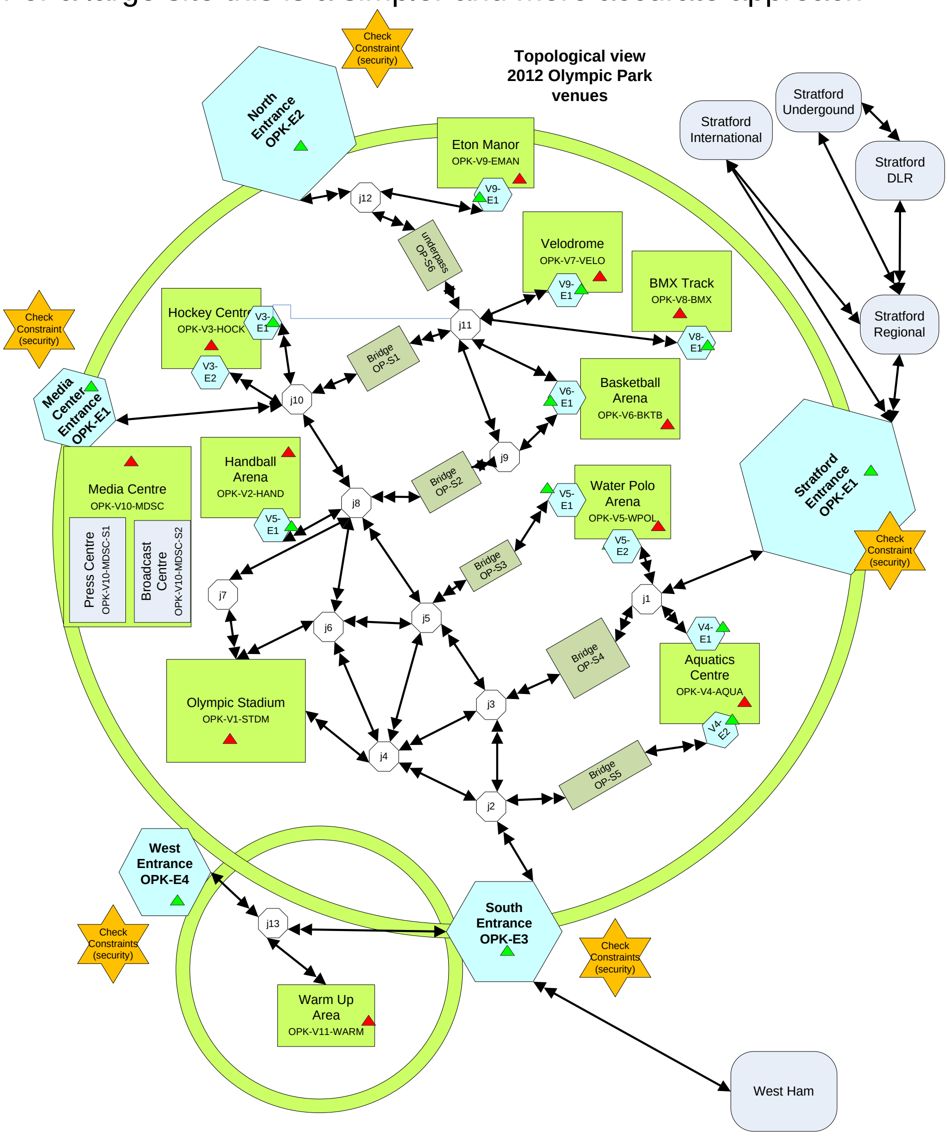


Figure 10 – 2012 Olympic Park with path links

2.12 *Figure 11* shows the actual course of a route from Stratford Underground station to the BMX Track overlaid onto *Figure 10* a circuitous route that involves going past several other areas Rather than the short direct line indicated by the Navigation path arrow.

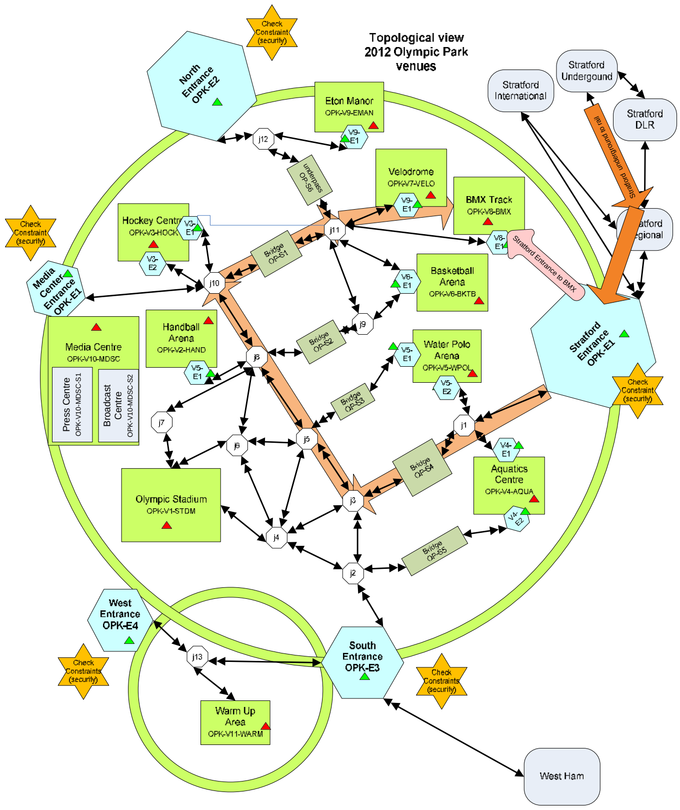


Figure 11 – Example Navigation from Stratford Entrance to BMX Track

2.13 Even without the full path link level of representation of *Figure 10* it would be possible to represent navigation of the site more simply than with the 27 odd many-to-many combinations used in *Figure 9*. Many routes share the same sections for example, the Velodrome, BMX Track and Basketball Arena are clustered in the north east and the path from the Northern entrance to all other areas goes past them. Similarly the Aquatics venues are adjacent to the Stratford entrance. *Figure 12* shows a revised version of *Figure 8* that introduces some intermediate nodes corresponding to these main vicinities – this gives a very high level understanding of the topology of the park site.

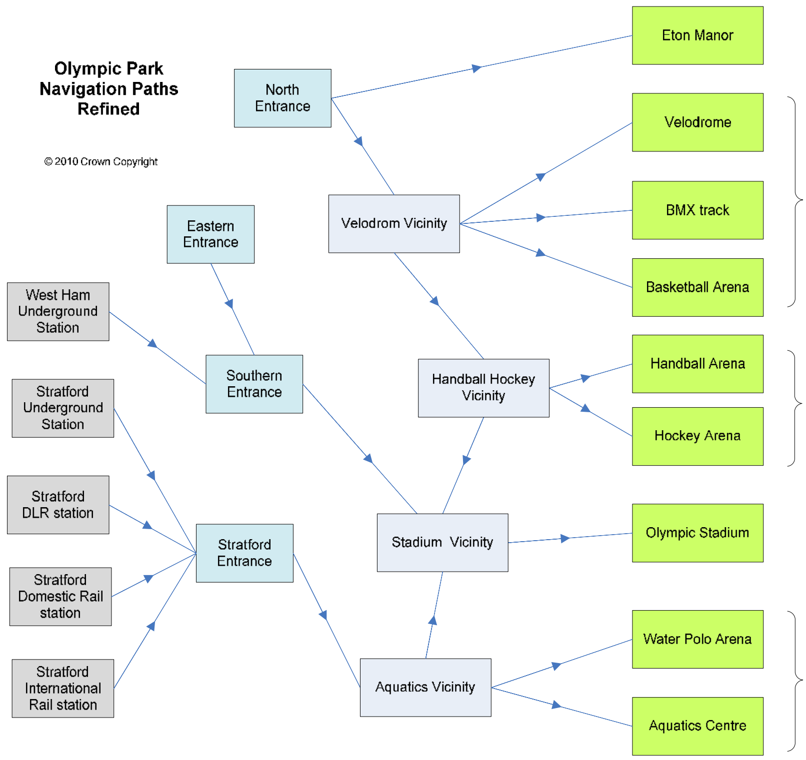


Figure 12 – 2012 Olympic Park: constrained transfers

3 2012 Olympic Park Access by Public Transport

3.1 This section summarises the major transport links for the 2012 Olympic Park. The gateway stations are the designated stations to which journey planners plan to provide journeys to a venue. Table 1 from the Olympic Travel Plan summarises access.

Games Family Games	Family vehicles will use the ORN/PRN to access the venue. Games Family vehicles will approach the venue via one of four entry points Eton Manor, Marshgate Lane, Bow West and Lea Valley Interchange
	The vehicles will set down and pick up at the load zones and car parks at each of the venues, with the majority of car parking provided within the Stratford City development and the IBC/MPC multi storey car park.
	There will be an Athlete bus and coach mall at the Olympic Village, which will act as the hub for Athlete bus service; a Media bus and coach mall on the ground floor of the multi-storey car park will host services to all competition venues and media accommodation; and there will be a coach park for marketing partners at the Pudding Mill Lane entrance.
Spectator access points	There will be four pedestrian access points to the Olympic Park for spectators: (refer to Figure 7.2)
	– Northern Access via the Northern Spectator Transport Mall
	– Eastern Access via the Stratford City Development
	– Southern Access via The Greenway
	– Western Access via The Greenway
Rail	There will be three gateway stations into the Olympic Park. These are:
	– Stratford International Station (including the DLR)
	– Stratford Regional Station
	– West Ham Station
	During the Olympic Games a rail shuttle service will be operated from Kings Cross St. Pancras to Stratford International Station and on to Ebbsfleet. This temporary Games-time service known as the Javelin® will be a key contributor to the Olympic Park spectator transport strategy with up to 12 trains per hour running at peak times.
River	There is no water-borne access to this venue.
Walk/cycle	Cycle parking will be provided at the following locations (see figure 7.2):
	– Northern Spectator Transport Mall (NSTM) (2,000 spaces)
	– Southern Spectator Transport Mall (SSTM) (200 spaces)
	– Victoria Park (5,000 spaces)
	There may also be some potential for cycle parking at Stratford Regional Station although this requires further investigation. Approximately one per cent of spectators are forecasted to walk all of the way to the Olympic Park.
Bus and coach	A direct coach service will bring eight per cent of spectators to the Olympic Park. See chapter 6 of the Olympic Travel Plan for further information regarding direct coach services. The direct coach services will drop off and pick up in the NSTM.
Blue Badge parking	Currently there are two proposed locations for Blue Badge parking to serve the venue.
	– NSTM: 411 spaces
	– SSTM: 153 spaces
Park-and-ride	A park-and-ride service will bring 10 per cent of spectators to the Olympic Park. Park-and-ride services will drop off and pick up at the SSTM.

Table 1 Modes of access to Stratford Site (Olympic Travel Plan)

3.2 It is estimated that over 80% of spectators will come by rail and there will be capacity for 240,000 passengers per hour. The main rail and tube transport for the Olympic Park is at Stratford. Stratford International is served by international and regional high speed trains (This will include the direct Javelin shuttle service from St Pancras every six minutes); Stratford Regional Station is served by the London Underground (Central Line & Jubilee Line), DLR, and London bus services. Stratford has rail services from London Overground and National Rail. West Ham station is also relevant for venues near the southern entrance to the park.

3.3 *Figure 13* shows the metro lines around Stratford.

3.4 West Ham Station is served by the London Underground (District Line, Hammersmith & City, and Jubilee Line), DLR, and London buses. Stratford has rail services from London Overground and National Rail.

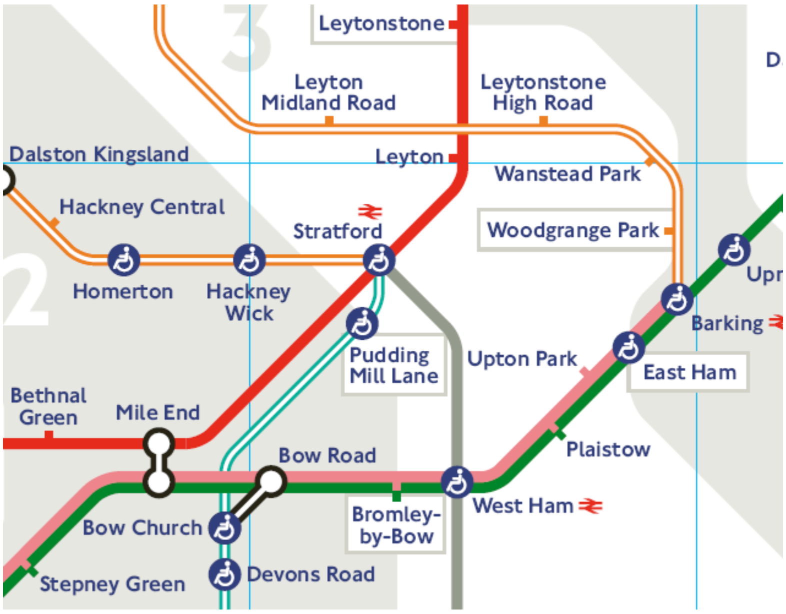


Figure 13 – Stratford underground and DLR connections (www.tfl.gov.uk)

TfL maps give an overall indication of accessibility at the station level. Stratford is flagged as a wheelchair-accessible station.

Both Stratford International & Stratford Regional Station are themselves relatively complex sites with a number of entrances and different platforms for each service and direction. For example, *Figure 14* and *Figure 15* shows the upper and lower levels of Stratford Regional Station as it will be modernised for the Olympics. This is likely to result in different access times for different modes (e.g. DLR versus tube) and for different accessibility constraints (e.g. wheelchair, or lift free). An end to end navigation path from a given platform to a given venue will take all of these into account.

3.7 There are a number of bus stops that serve points on or around the Stratford Stations and the 2012 Olympic Park.

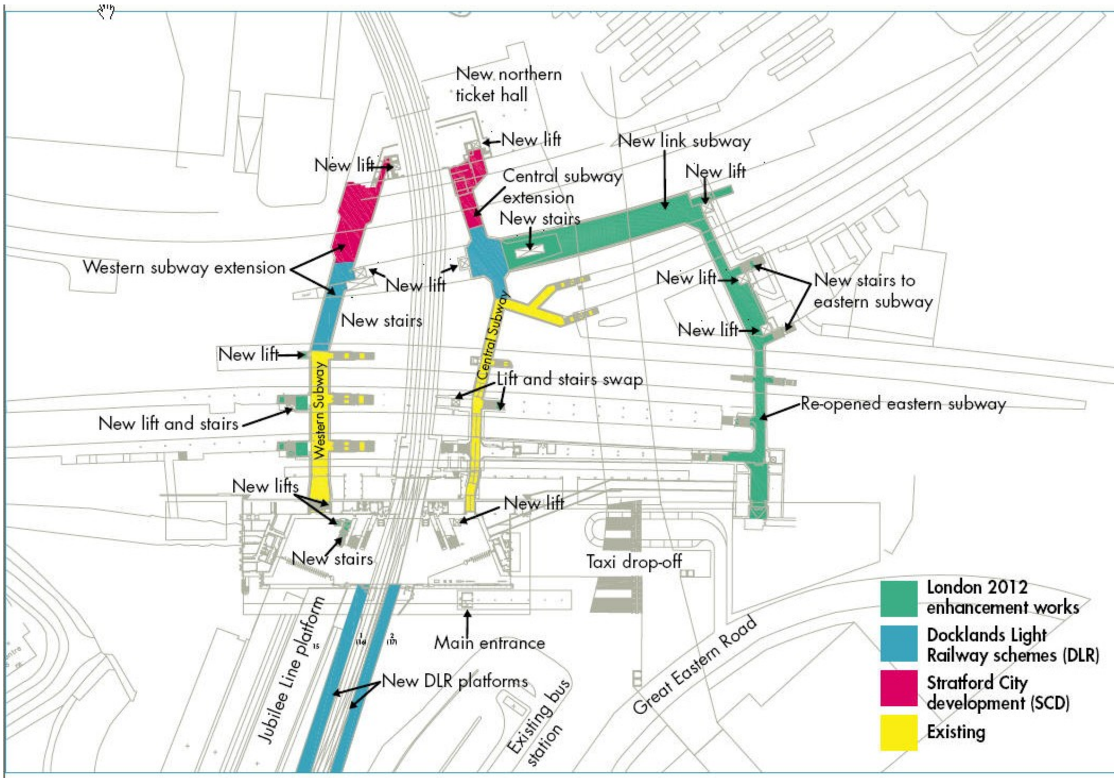


Figure 3 Subway level plans showing access enhancements at Stratford Regional Station.

Figure 14 – Upper Level of Stratford Regional Rail Station (www.London2012.com)

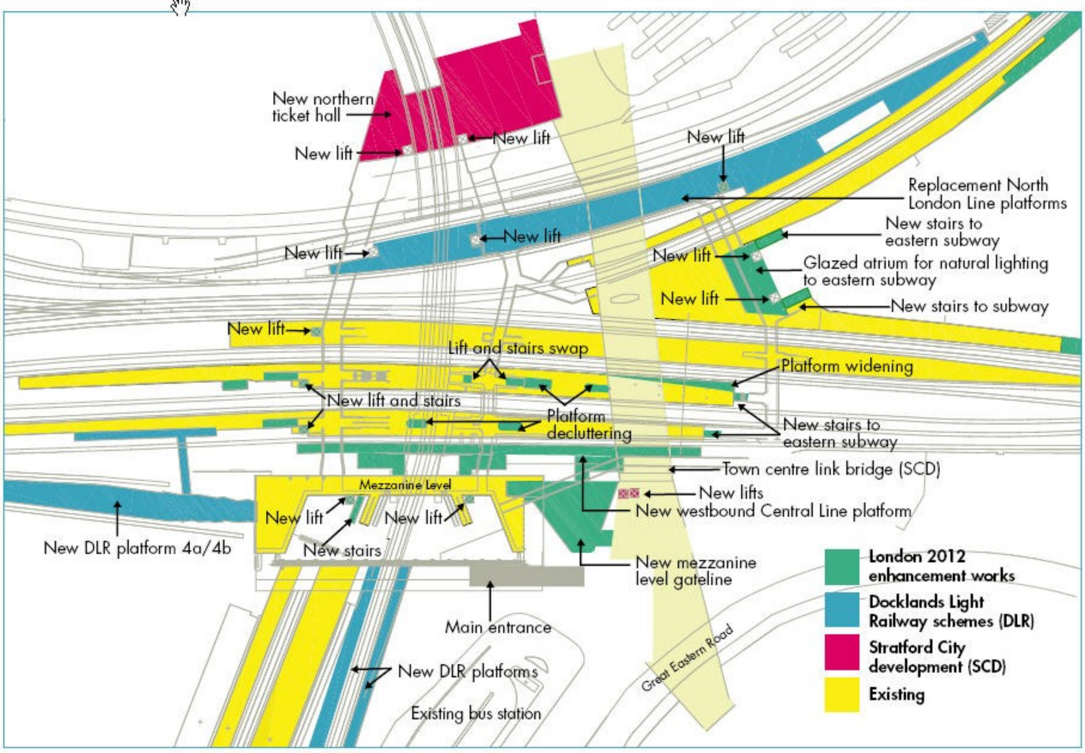


Figure 4 Upper level plans showing access enhancements at Stratford Regional Station.

Figure 15 – Lower level of Stratford Regional Station (www.London2012.com)

3.8 Each of the Gateway Stations will be represented in NaPTAN by NaPTAN Stop points describing the station, entrances and potentially platforms.

- For the two rail stations Stratford International and Stratford regional the will be distinct RLY, RSE (entrance) (and potentially RPL) points. These can be grouped with a Stop Area of type GRLY.
- For the two tube stations at Stratford International and Stratford regional there will be distinct MET, TMU (entrance) and PLT points. These can be grouped with a Stop Area of type GRLY
- For the two tube stations at Stratford International and Stratford regional there will be distinct MET, TMU (entrance) and PLT points. These can be grouped with a Stop Area of type GTMU.
- For the DLR station at Stratford there will be distinct MET, TMU (entrance) and PLT points. These can be grouped with a Stop Area of type GTMU

3.9 There will be a number of local bus stops in the vicinity of the completed Olympic site that will be suitable for visitors approaching by bus from different directions. For example (*Figure 16*) shows a TfL spider map of bus stops considered to serve the Stratford interchange.

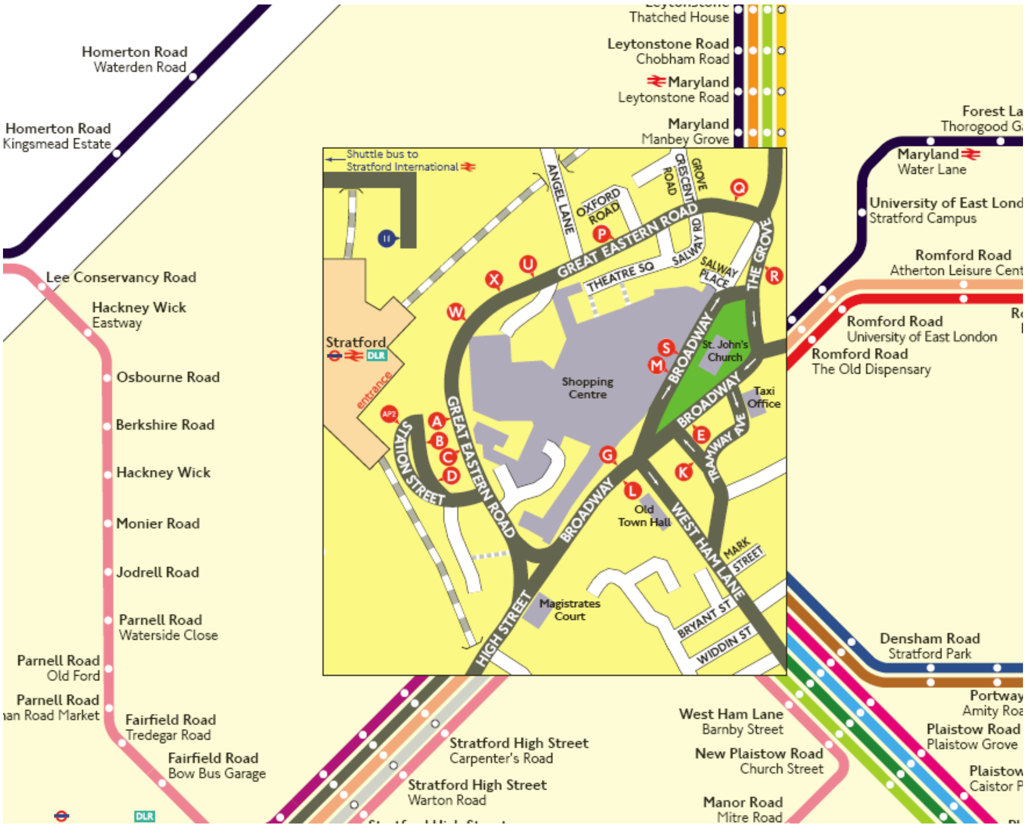
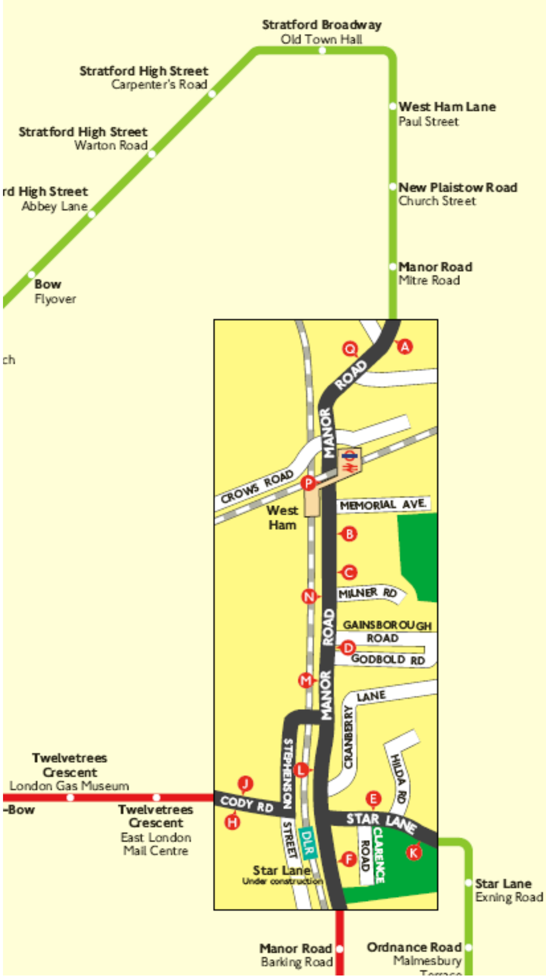


Figure 16 – Bus stops near 2012 Olympic Park (TfL Spider map)

3.10 There will be distinct NaPTAN BCT points for each on-street bus stop; The bus stops can associated with the station through the use of a NaPTAN stop area of type GCLS

3.11 Similarly (*Figure 16*) shows a TfL spider map of bus stops considered to serve West Ham.

Figure 17 – Bus stops near West Ham (TfL Spider map)



3.12 Some detailed data is available describing the internal navigation of the station.

3.13 West Ham station is described in the London Underground Direct Enquiries site (http://www.directenquiries.com) which provides narrative tools for examining the station.

3.14 For TfL LU stations such as West Ham, Direct Enquiries provides users with information on the accessibility of routes from the station entrance to any of the platforms (including the rail platforms). A list of navigation paths is provided for every transition between every entrance and platform and for underground / underground and underground / rail transfers. These are grouped in three headings '*Entrances*', '*Halls to Platform*' and '*Interchanges*' –*Figure 18* shows the names of the first few navigation paths in the list.

Entrances

Manor Road to
- Entrance to Ticket Hall
- Ticket Hall to Exit

Halls to platform

Ticket Hall to
- District and Hammersmith & City Westbound (Platform 1)
- District and Hammersmith & City Eastbound (Platform 2)
- Jubilee Westbound (Platform 5)
- Jubilee Eastbound (Platform 6)
- National Rail (Platform 7)
- National Rail (Platform 8)

Platforms to Halls

District and Hammersmith & City Westbound (Platform 1) to
- Ticket Hall

District and Hammersmith & City Eastbound (Platform 2) to
- Ticket Hall

Jubilee Westbound (Platform 5) to
- Ticket Hall

Jubilee Eastbound (Platform 6) to
- Ticket Hall

National Rail (Platform 7) to
- Ticket Hall

National Rail (Platform 8) to
- Ticket Hall

Interchanges

District and Hammersmith & City Westbound (Platform 1) to
- District and Hammersmith & City Eastbound (Platform 2)
- Jubilee Westbound (Platform 5)
- Jubilee Eastbound (Platform 6)
- National Rail (Platform 7)
- National Rail (Platform 8)

District and Hammersmith & City Eastbound (Platform 2) to
- District and Hammersmith & City Westbound (Platform 1)
- Jubilee Westbound (Platform 5)
- Jubilee Eastbound (Platform 6)
- National Rail (Platform 7)
- National Rail (Platform 8)

Jubilee Westbound (Platform 5) to
- District and Hammersmith & City Westbound (Platform 1)
- District and Hammersmith & City Eastbound (Platform 2)
- Jubilee Eastbound (Platform 6)
- National Rail (Platform 7)
- National Rail (Platform 8)

Jubilee Eastbound (Platform 6) to
- District and

Figure 18 Partial list of Navigation Paths (DirectEnquiries.com – LU)

3.15 Each individual path can be displayed as a step by step description of path links; each step corresponding to use of stairs, level, ramp or lift/escalators (*Figure 19*). Note that if a POINT OF INTEREST site model is populated to a similar level of detail, similar blow by blow instructions can be provide for use of a venue.

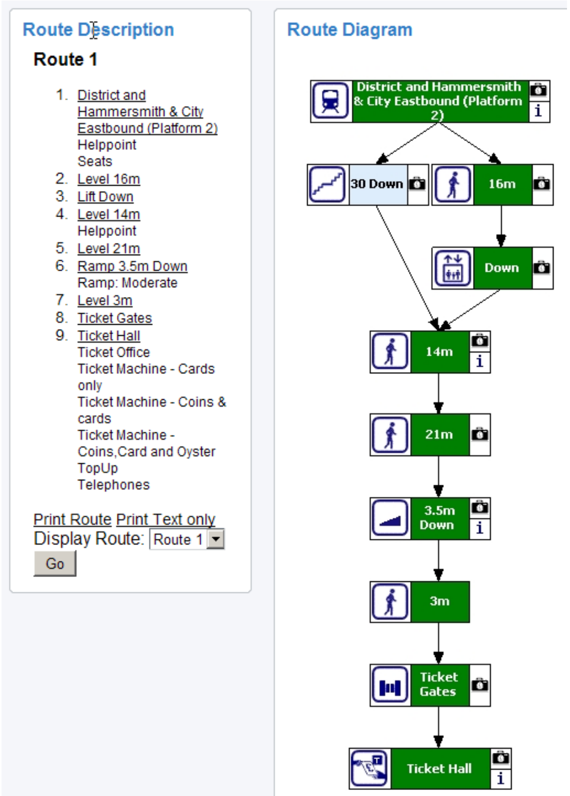


Figure 19 Example of Interchange Navigation Path (DirectEnquiries.com – LU)

3.16 The NeTEX /IFOPT model is capable of representing the location and capacity of Blue Badge parking for disabled users. However this is not a requirement of the proposed scope of work.

4 2012 Olympic Park & NeTEx / IFOPT

4.1 The NeTEx / IFOPT standard enables the modelling of all the different elements of a 'SITE' (that is venue, point of interest, or other complex destination) including the component areas of the site, the levels, the paths through the site and the various types of equipment found when navigating the site such as entrance barriers and lifts, stairs and, signs. It also allows detailed accessibility attributes to be recorded at both the element and the site level.

4.2 Such a model is fundamentally *topological* one: it is concerned just with the connectivity of the main public areas so that users may be guided with them. It is not concerned with exact spatial layout.

4.3 In this section we will show how some of the NeTEx model can be used to provide a standardised representation of a complex site using the 2012 Olympic Park example, anchored on Entrance and Venue points similar to the points used in NaPTAN data. This is not an exhaustive account of the NeTEx model's capabilities, but focuses on aspects relevant to the point of interest data discussed above. The NeTEx model is described elsewhere technically by a UML model which highlights the objects, attributes and relationships needed to represent an interchange. A summary extract is available as a separate paper. Here we avoid the use of UML.

4.4 The core elements of the NeTEx site model are a SITE element and the various spaces of which it is comprised, such as entrances (ENTRANCEs), and concourse areas (POI SPACEs), etc. A POINT of INTEREST is a type of SITE that can be used to represent a venue (in contrast to a STOP PLACE, which is a type of SITE used to represent a station or other public transport access point).

4.5 An outer SITE, e.g. The 2012 Olympic Park can contain other SITEs – e.g. the individual venues – in a hierarchical organisation. Each SITE can contain one ore more ENTRANCEs, and have one or more POI SPACEs describing its interior – although it is not a requirement of the 2012 Olympics to do so.

4.6 *Figure 20* below shows the use of IFOPT structural elements to organise the 2012 Olympic Park as a hierarchy of related elements. (NB Again this is an approximation to show the principles involved, rather than an exact finished representation). Each of the nodes can have geospatial coordinates so that it can be projected onto a map visualisation.

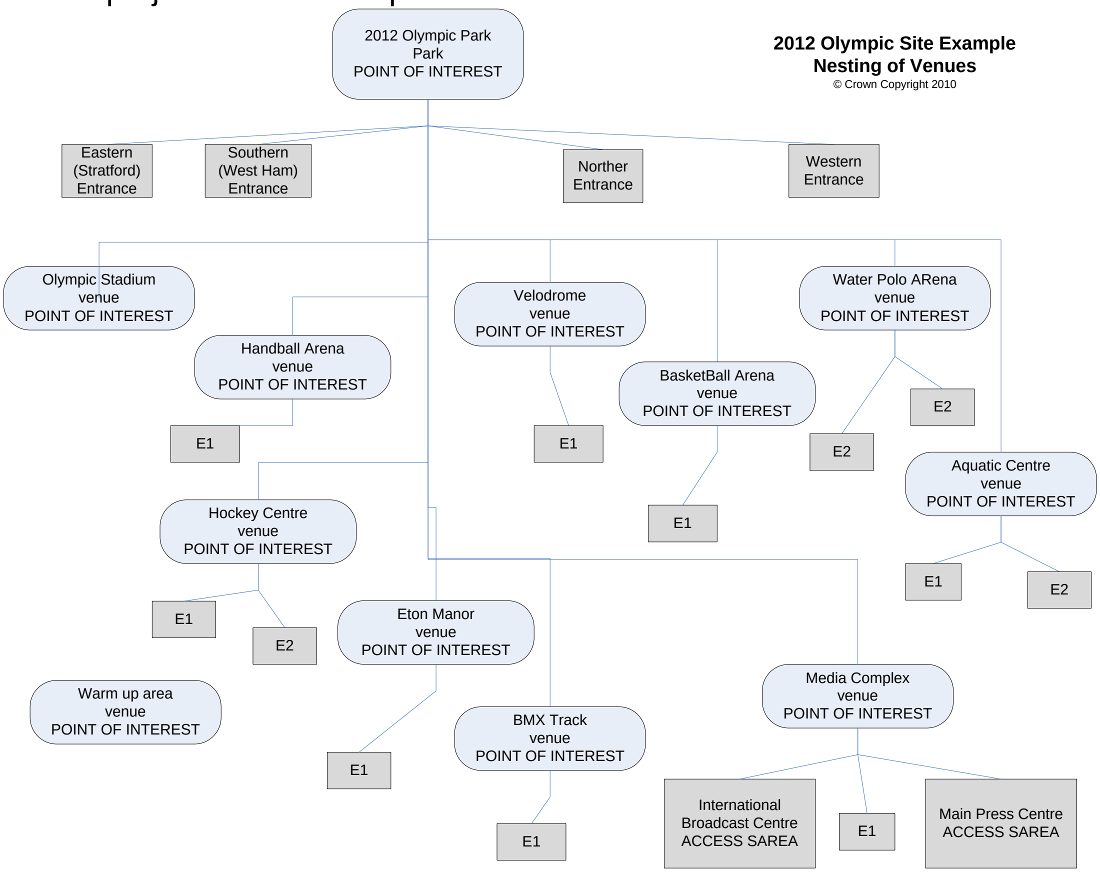


Figure 20 2012 Olympic Park NeTEx / IFOPT nodes

4.7 The fundamental elements can be issued with unique NaPTAN identifiers and be treated as NaPTAN points (Entrances, Access Areas) by a journey planner. *Table 2* below show these key IFOPT structural nodes for the 2012 Olympic Park, and a few of the similar nodes for the gateway stations.

NeTEx / IFOPT Type	NeTEx /IFOPT component Description	Part of	Mode	NaPTAN Type	Possible NaPTAN Point Code

POINT OF INTEREST	*2012 Olympic Park*		walk	Point Of Interest POI	*8100OPK*
ENTRANCE	*2012 Olympic Park Stratford Entrance*	*2012 Olympic Park*	walk	Point Of Interest Entrance PIE	*8100OPK_E1*
ENTRANCE	*2012 Olympic Park North Entrance*	*2012 Olympic Park*	walk	Point Of Interest Entrance PIE	*8100OPK_E2*
ENTRANCE	*2012 Olympic Park South Entrance*	*2012 Olympic Park*	walk	Point Of Interest Entrance PIE	*8100OPK_E3*
ENTRANCE	*2012 Olympic Park East Entrance*	*2012 Olympic Park*	walk	Point Of Interest Entrance PIE	*8100OPK_E4*
POINT OF INTEREST	*Olympic Stadium*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_STDM*
POINT OF INTEREST	*Hockey Centre*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_HOCK*
ENTRANCE	*Hockey Centre Entrance 1*	*Hockey Centre*	walk	Point Of Interest Entrance PIE	*8100OPK_HOCK_E1*
ENTRANCE	*Hockey Centre Entrance 2*	*Hockey Centre*	walk	Point Of Interest Entrance PIE	*8100OPK_HOCK_E2*
POINT OF INTEREST	*Handball Arena*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_HOCK*
ENTRANCE	*Handball Arena Entrance 1*	*Handball Arena*	walk	Point Of Interest Entrance PIE	*8100OPK_HAND_E1*
POINT OF INTEREST	*Aquatics Centre*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_AQUA*
ENTRANCE	*Aquatics Centre Entrance 1*	*Aquatics Centre*	walk	Point Of Interest Entrance PIE	*8100OPK_AQUA_E1*
ENTRANCE	*Aquatics Centre Entrance 2*	*Aquatics Centre*	walk	Point Of Interest Entrance PIE	*8100OPK_AQUA_E2*
POINT OF INTEREST	*Water Polo Arena*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_WPOL*
ENTRANCE	*Water Polo Arena Entrance 1*	*Water Polo Arena*	walk	Point Of Interest Entrance PIE	*8100OPK_WPOL_E1*
ENTRANCE	*Water Polo Arena Entrance 2*	*Water Polo Arena*	walk	Point Of Interest Entrance PIE	*8100OPK_WPOL_E2*
POINT OF INTEREST	*Warm up Area*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_WARM*
POINT OF INTEREST	*Velodrome*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_VELO*
ENTRANCE	*Velodrome Entrance 1*	*Velodrome*	walk	Point Of Interest Entrance PIE	*8100OPK_VELO_E1*
POINT OF INTEREST	*BMX Track*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_BMXT*

ENTRANCE	*BMX Track Entrance 1*	*BMX Track*	walk	Point Of Interest Entrance PIE	*8100OPK_BMXT_E1*
POINT OF INTEREST	*Basketball Arena*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_BKTB*
ENTRANCE	*Basketball Arena Entrance 1*	*Basketball Arena*	walk	Point Of Interest Entrance PIE	*8100OPK_BKTB_E1*
POINT OF INTEREST	*Eton Manor*	*2012 Olympic Park*	walk	Point Of Interest POI	*8100OPK_EMAN*
ENTRANCE	*Eton Manor Entrance 1*	*Eton Manor*	walk	Point Of Interest Entrance PIE	*8100OPK_EMAN_E1*
STOP PLACE	*Stratford International rail Station*		rail	StopArea	*Existing 910*
STOP PLACE	*Stratford Regional rail Station*		rail	StopArea	*Existing 910*
STOP PLACE	*Stratford Underground Station*	*Stratford Regional rail Station*	metro	StopArea	*Existing 930*
STOP PLACE	*Stratford DLR Station*	*Stratford Regional rail Station*	metro	StopArea	*Existing 930*
STOP PLACE	*West Ham Underground Station*	*West Ham Regional rail Station*	metro	StopArea	*Existing 930*
etc					

Table 2 IFOPT Nodes with NaPTAN equivalents

4.80 As noted earlier, in the illustrative use of IFOPT node elements for the 2012 Olympic Park in this paper (see Figure 7), the 2012 Olympic Stadium and the warm up area are not given entrances. Also, because the journey planning does not require a detailed in building plan (for example to choose the right entrance for a given section of stadium) most venues are given just as single ACCESS AREA Only the Media centre is given more than one designated ACCESS AREA for its two sections. The use of POI SPACEs to model the interior of a site is discussed briefly later below.

4.81 CHECK CONSTRAINTs can be assigned to the nodes where delays may take place at particular times, for example, at ENTRANCEs for security process going in and for egress at the end of events. These can be used to give more realistic journey times and to warn users of potential bottlenecks of which they might not be aware, (for example trying to by a TfL ticket at a station in rush hour). For the 2012 Olympic Park it would be useful to record expected delays at security points and for ingress/ egress.

4.82 Each CHECK CONSTRAINTs describes a process, such as ticketing, queuing, existing a building, etc. For each constraint, one or more CHECK DELAYs can be specified stating the actual expected delay.

4.83 To specify when the CHECK DELAY applies, a VALIDITY CONDITION is used. The VALIDITY CONDITION can specify the DAY TYPE and optional TIME BAND to when the delay applies. The DAY TYPE can be defined to suit the local requirements – for example one might have a day time "*Weekdays", "Weekend", "Weekday Public Holiday",* etc or one might have an event based classification "*Very busy day", "Busy Day, "Normal Day", "Quiet Day".* The day type can be reused in may places independent of a date. To tie in the DAY TYPE with a specific calendar date, a DAY TYPE ASSIGNMENT is used. For example this might state that 27/07/2012 and 7/08/2012 (the opening day and closing days) are both "Very Busy days", whilst other days are "Normal days", apart from the preopening days which are "Quite days". This means that all delays assigned to "Very Busy Day " will apply.

4.84 The following two tables, using purely notional categories and values to show the principles, assuming four day types and three time bands.

TIMEBAND	Morning Arrival (09-11am)	During (11-16)	Evening Exit (08-12(
DAY TYPE			
Very busy day	CND01a	CND02a	CND03a
Busy day	CND01b	CND02b	CND03b
Normal Day	CND01c	CND02c	CND03c
Other	CND01d	CND02d	CND03d

Table 3 Example Validity Conditions as combinations of Day Types & bands

CoDITION	Minimum Delay	Average Delay	Maximum Delay
CND01a	10M	20M	60M
CND01b	10M	20M	40M
CND01c	10M	15M	20M
CND01d	10M	12M	15M
CND02a	10M	15M	50M
CND02b	10M	20M	30M
CND02c	10M	15M	150M
CND02d	10M	12M	15M
CND03a	5M	10M	20M
CND03b	5M	10M	30M
CND03c	5M	15M	20M
CND03d	5M	12M	15M

Table 4 Example Delays by Condition

4.85 A SERVICE CALENDAR is used to group the DAY TYPES, TIME BANDs, DAY TYPE ASSIGNMENTS, etc. A specific SERVICE CALENDAR could be created for the Olympic period with assignments of each date to a specific DAY TYPE. The DAY TYPE mechanism provides a powerful mechanism for describing without having to repeat

4.86 VALIDITY CONDITIONs can also be used to state when a given ENTRANCE PATH LINK, or other component is available for use.

4.87 The IFOPT model enables the creation of PATH LINKs between the elements of a SITE (i.e. POINT OF INTEREST or STOP PLACE). Each SITE comprises one or more POI SPACEs; PATH LINKs connect POI SPACEs either generally or at specified ENTRANCEs. Each PATH LINK can also describe any change in LEVEL, for example between the concourse and lower ground, as well as any EQUIPMENT (lift, steps etc) associated with that PATH LINK and the time taken for the PATH LINK. PATH LINKS state in which directions they can be used.

4.88 Sequences of PATH LINKs can be assembled into named NAVIGATION PATHs to connect a start and end point. In an implementation these NAVIGATION PATHs can either be predefined statically, or be computed dynamically by a micro journey planner, Paths can be filtered according to the specific needs of the users, for example steps or escalators.

4.89 The model for NAVIGATION PATHs is thus two-level, as shown earlier in (Figure 11). Simple point to point PATH LINKs are used to link nodes of a SITE: Nodes may be POI SPACEs (green or grey rectangles) or PATH JUNCTIONs (white octagons) – intermediate branch points. PATH JUNCTIONs make it possible to use the same links in many different NAVIGATION PATHs. A link may also indicate a specific ENTRANCE of the node – but it doesn't have to.

4.90 NAVIGATION PATHs can hold summary level information on timing and accessibility, for example the overall time to traverse the PATH LINKs, the distance, and the total number of steps. It is possible to have a just a summary NAVIGATION PATH to describe the overall connectivity from origin to destination without filling in the PATH LINKs describing the individual steps. For the 2012 Olympics Park this would be sufficient to hold the connection routes. Note however that it is actually less work to specify the individual path links and compute the NAVIGATION PATHs, than to specify all the point to point transitions by hand.

4.91 Since the Park will be purpose built we assume all of the paths and entrances in the 2012 park will be wheelchair accessible. This means that specific routes do not need to be distinguished. If however certain places or links are not accessible to all users 9as is often the case in existing sites or in stations) then these can be flagged with their accessibility characteristics e.g. *wheelchair, step free, lift free*, etc. This enables journey planners to find routes that meet given accessibility requirements.

4.92 The LEVELs used in IFOPT are named components that correspond to the labels used to describe complex sites to users such as '*Mezzanine', 'Street'*, 'Upper Terrace', etc. Unless building interiors need to be described, a single level will probable suffice for the 2012 Olympic Park.

4.93 POI SPACES can be nested; this allows one to use a more detailed representation of part of a site if needed

4.94 The topological model can then be annotated with equipment, images and other elements that describe detailed properties of the interchange, for example, lifts, or stairs, ticket barriers, surfaces, and their detailed accessibility properties. IFOPT provides a systematic set of standardised EQUIPMENT objects, describing different types of equipment including ticket machines, doors, gates, ramps, seats, phones and information displays with standardised attributes. EQUIPMENT can be located within a space using EQUIPMENT PLACE using both relative (e.g. 6m along) or absolute (e.g. WGS coordinates). EQUIPMENT does not need to be populated for basic journey planning.

4.95 Equipment can include the signs that spectators will see at particular points to guide them on their way.

4.96 The NeTEx model may be used for different levels of detail. For example *Figure 21* shows a basic representation of a large stadium that has two distinct sets of entrances from different roads on either side. This is the level of detail that is suggested for most Olympic Site venues in Figure 7.

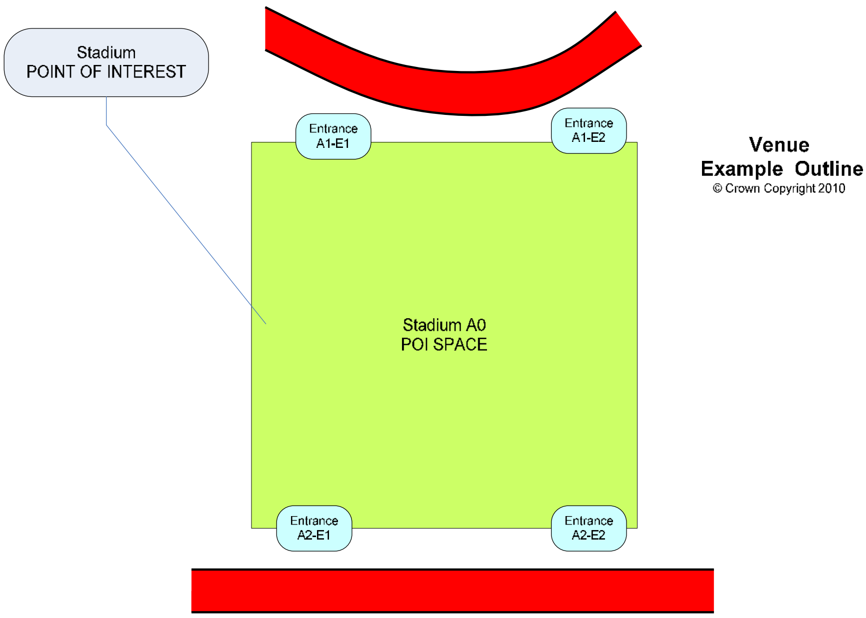


Figure 21 – Simple representation of a sports Stadium

4.97 The 2012 Olympic Park example is not concerned with the internals of the site. *Figure 22* shows slightly more elaborate representation of the same stadium (i.e. one that further populates the basic model from *Figure 21* with additional elements) to distinguish an entrance hall with a security process. Spectator tickets for events at the stadium could be assigned to one or other security area and different journey plans provided according to the desired destination. For the Olympic Park in Figure 7 POI SPACEs are used only to distinguish the areas of the press centre.

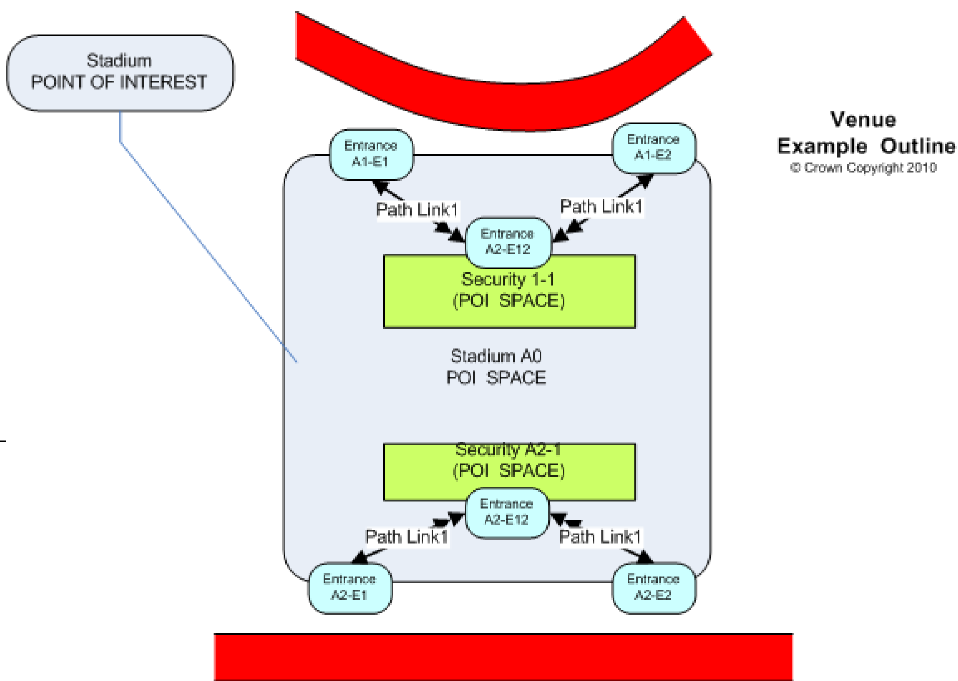


Figure 22 – Basic representation of a sports stadium

4.98 *Figure 23* below shows a more detailed representation of the same stadium with some of the spaces, stairs, internal entrances, etc, making up the first level of the stadium shown. Equipment such as stairs and toilets can be marked. This would allow one to provide detailed step by step directions to a spectator to reach a specific grand stand from the correct entrance. If annotated with accessibility data can also be used to provide accessible travel plans.

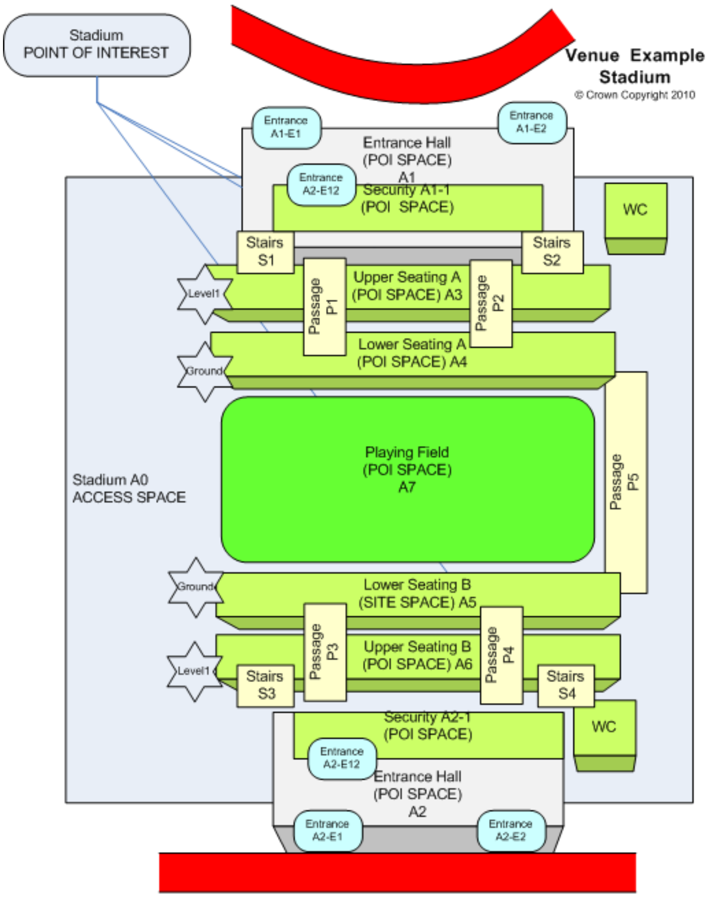


Figure 23 – More detailed representation of a sports stadium

5 Wembley Stadium Additional example of a complex venue

5.1 The discussion of the 2012 Olympic Park above did not concern itself with the internals of the venue buildings. However for some large buildings the internal structure can be related to journey planning and navigation, for example to find the best entrance for a given seating bank, or an accessible route for a wheelchair. In this section we look briefly at journey planning to stadiums, using Wembley Stadium as an additional example of a very large building of a type that a standard model should be able to describe if desired. As Figure 25, Figure 26, Figure 27 and Figure 28 show, excellent published plans for Wembley stadium can be found at http://www.wembleystadium.com showing both access routes (from Wembley Central or Wembley park) and the layout of the stadium.

5.2 From these it can be seen that the elements shown on the plan (entrances, levels, paths, areas, equipment, etc) could be represented electronically for journey planning applications using the same NeTEx /IFOPT model elements discussed above.

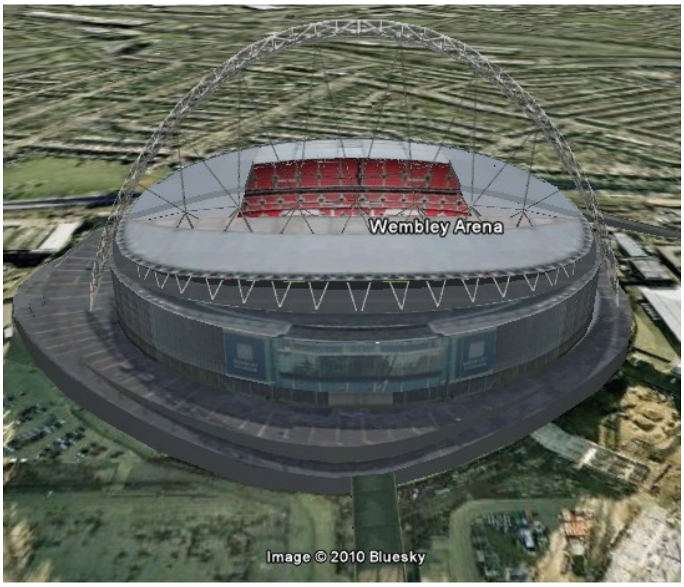


Figure 24 Wembley stadium (www.googlearth.com)

Figure 25 – Wembley Stadium Access (www.wembleystadium.com)

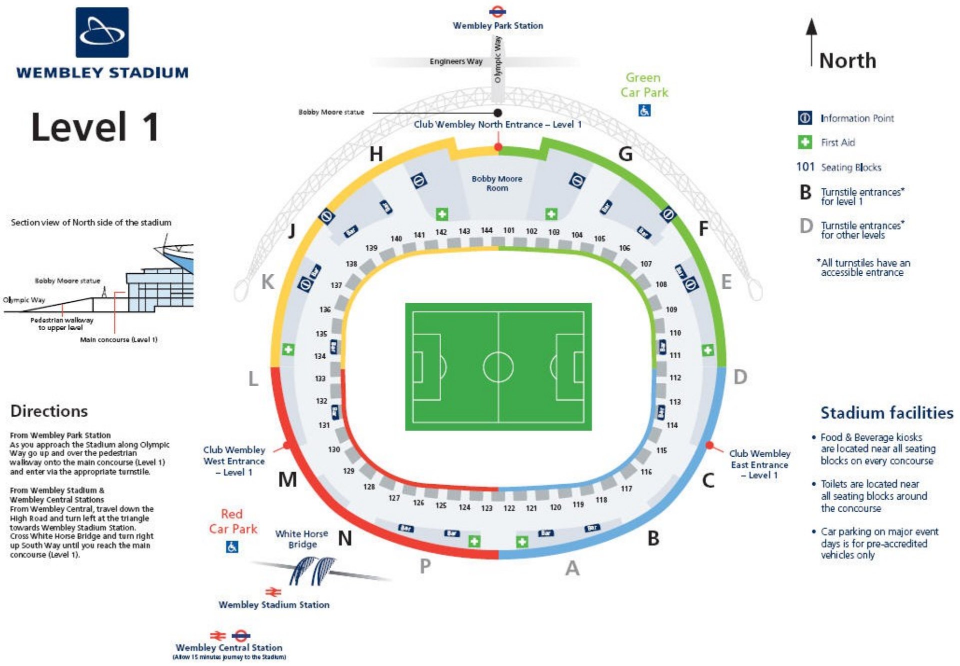


Figure 26 – Wembley Stadium Level 1 (www.wembleystadium.com)

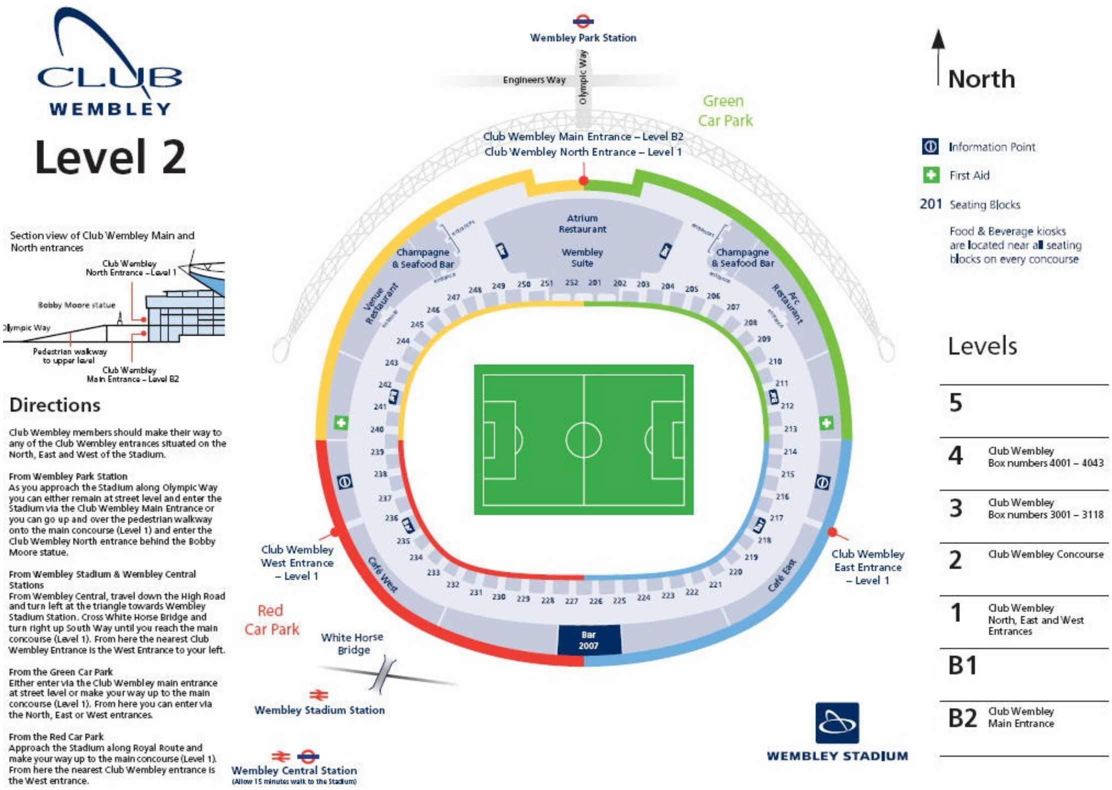


Figure 27 – Wembley Stadium Level 2 (www.wembleystadium.com)

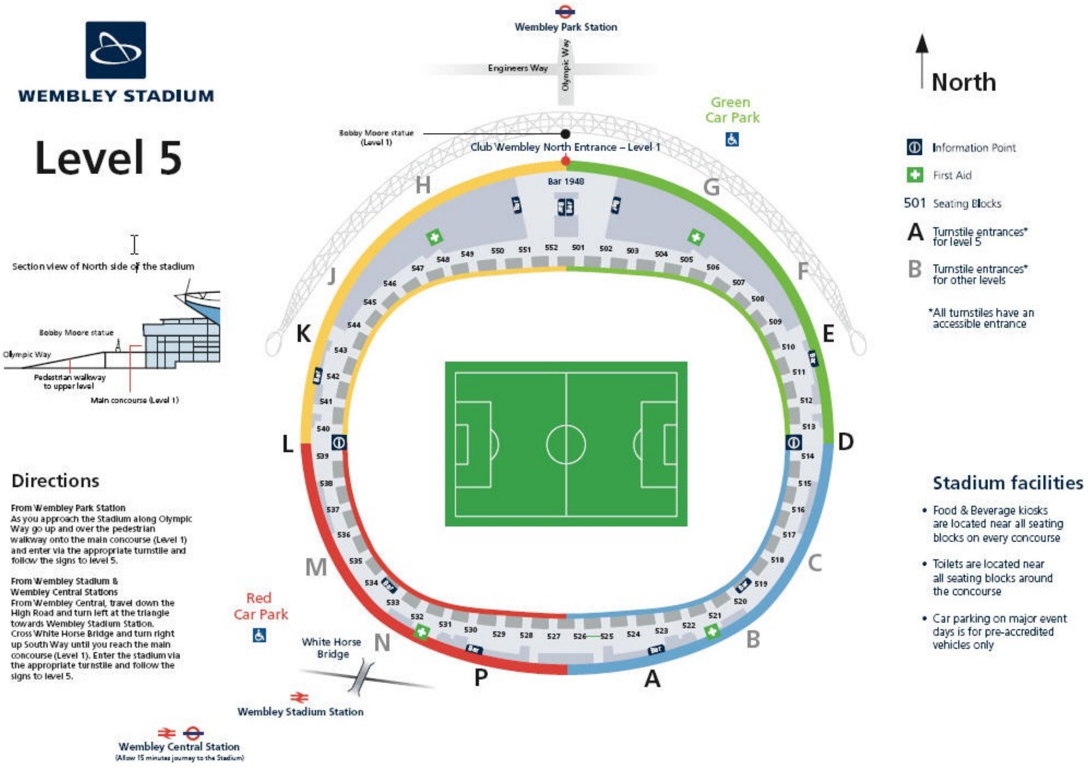


Figure 28 – Wembley Stadium Level 5 (www.wembleystadium.com)

The actual level of detail that it is useful to hold depends on the application. The schematic diagrams above show considerable detail. A ‘Wembley Stadium site navigator for the blind’ might be interested in a detailed description of every floor path, so as to provide a descriptive navigator. If however the application is to just to suggest the best entrance by which to approach a particular seating block of the stadium then a simpler subset of elements might suffice. As the stylized seating plans from http://www.wembleystadium.com show, the public spectator areas are on three levels (shown in Figure 29 as concentric rings), truncated at one end for concerts (Figure 30). In Figure 26, Figure 27 and Figure 28 the seating blocks in each ring are grouped into one of four coloured quadrants, each associated with fourteen separate zones (labelled A, B, C etc …to P). This might suggest that the stadium could be adequately described as a choice of twelve areas – four quadrants on each level.

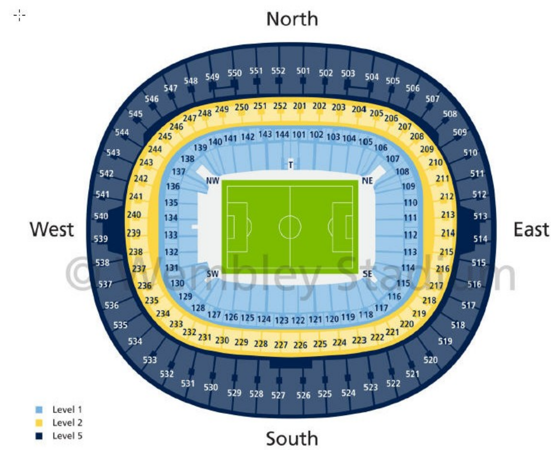


Figure 29 – Wembley Stadium Sports Event seating plan

Figure 30 – Wembley Stadium Concert Event seating plan

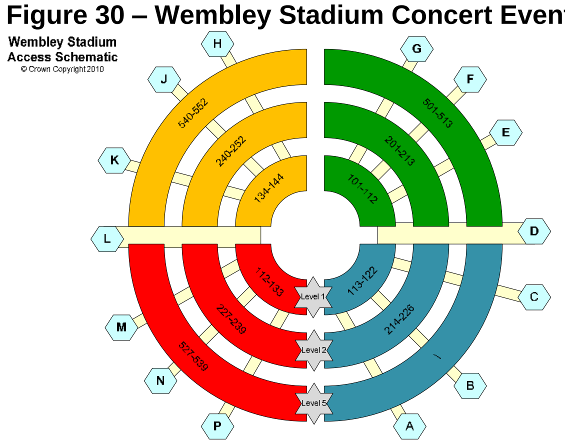


Figure 31 Schematic access map for Wembley

5.3 2012 Figure 32 and Figure 33 provide two further examples of stadium schematic plans: Figure 32show the seating blocks and Figure 33 shows the entrances and accessibility points.

Figure 32 Newcastle FC seat plan (www.nufc.com)

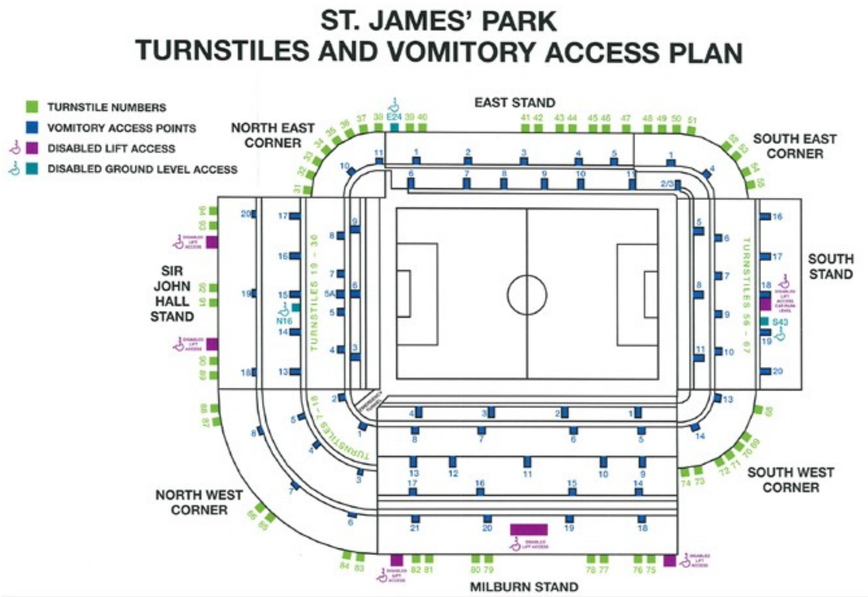


Figure 33 Newcastle Entrances (www.nufc.com)

6 2012 Olympic Legacy

6.1 The 2012 Olympic Park is an example of a complex point of interest for which multiple gateways stations and stops are relevant and for which an additional level of structural detail is useful, both to give better journey plans and to provide in site navigation. The model proposed for the Olympic site is equally relevant for any large site such as a park, sports complex or public building where the location of the entrances relative to public transport is germane.

7 Summary

7.1 Both accessibility support and improved journey planning require a richer data model of venues. However data is not available in a standard form that would allow it be readily collected and integrated with other systems, for example as part of a larger journey planning systems, or indeed in personalised applications for disabled users and that might encode the data into a personal device.

7.2 This paper shows how as standard model could be used to describe sites such as the 2012 Olympic Park to varying levels of detail. The same model can also describe complex transport interchanges, allowing consistent routing from platform to event.

7.3 The data can be use provide better journey plans – and to make planning to a complex site simpler for the user.

7.4 An important property of the NeTEx / IFOPT model is that it allows for incremental population. One may start with a minimal subset and over time fill in other elements to enrich the data set to support additional application capabilities.