

Structure of the Existing Bus Network



TRANSFORMING CITY BUS SERVICES



Underlying Conditions – Regional Transport Infrastructure

An effective public transport network requires both service and infrastructure. The bus network redesign is focused on service, and proposes service changes that could mostly take place with existing infrastructure. It is therefore useful to understand the general state of infrastructure underlying the bus network today.

The underlying infrastructure is significant, with known gaps and plans for improvement.

In Dublin, buses rely entirely on roads for rights-of-way. There are no rights-of-way fully reserved for buses. However, the amount of bus space reserved for buses on public roads may increase, with the improvements to the Core Bus Corridors.

Nonetheless, even today, a combination of measures taken by the National Transport Authority and local councils have resulted in a regional network of bus lanes and shared bus/bike lanes.

Although the network of bus lanes still has many gaps, there are bus lanes in every major radial corridor and on some orbital roads as well. This is shown in the map at bottom left.

Some outer orbital roads have bus lanes but not much bus service. This is not necessarily a problem, as these lanes help create the conditions for effective orbital services in the future.

One issue potentially impacting the effectiveness of bus lanes is the number of vehicles that are allowed to use them. For example, in Dublin, taxis are allowed to use most bus lanes. This may exacerbate speed and reliability problems in central areas where many bus routes converge.

The bus network is mutually supportive with the regional network of high-capacity all-day rail lines, mostly Luas and DART. The service on these rail lines relieves pressure in some of the highest-demand corridors, and in the City Centre.

Previously, the most pressing gap in the rail system was the termination of the Luas Green Line at St. Stephen's Green, before it connected with the Red Line, DART or regional rail. This problem has been addressed by the Luas Cross City project. One of the most pressing current issues with most rail services is extremely high peak-hour demand leading to overcrowding, which limits the amount of bus-to-rail interchange that the public transport network can support.

Service extends throughout the Dublin Metropolitan Area

As can be seen by the series of maps on the next page, existing PSO bus service reaches into all developed parts of the Dublin Metropolitan Area. Beyond the extent shown, several other bus routes extend its reach further into Fingal, as well as Counties Wicklow, Kildare and Meath.



Figure 57: The map below shows bus lanes in the Dublin area, as of 2016.



BUS CONNEC

Existing Network: Big Picture





EXISTING NETWORK

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The frequent bus network is entirely radial

The adjacent map¹ shows the extent of Dublin Bus routes that provide all-day service every 15 minutes or more often on weekdays. Every single route meeting this standard is radial, i.e. it connects outlying areas to the city centre.

Many of these are cross city routes, which connect different suburban locations by traversing the city centre. Cross city routes were significantly expanded by the Network Direct initiative², and have improved suburb-to-suburb connections between areas on different sides of the River Liffey.

Nonetheless, this pattern means that travel between areas on the same side of the city – e.g. Crumlin to Dundrum – requires either long waits or travelling to City Centre and back out. As suburban centres grow, the absence of high-frequency orbital service is becoming an increasing barrier to serving Dublinarea residents.



Figure 60: The map below shows the frequent network, i.e. routes that operate every 15 minutes or better during weekdays at midday (2019).



¹ Due to space constraints, several of the maps in this chapter focus on the area bounded by the Airport to the north, Shankill to the south, Lucan to the west, and the Howth peninsula to the east. This covers the vast majority of public transport service in the Dublin metropolitan area, but not all of it. In designing the proposed network, we considered existing service in all areas served by the public bus network beyond this map extent.

² Network direct was an initiative carried out by Dublin Bus from 2011 to 2013 which sought to simplify bus services in the Dublin area. In the course of Network Direct, many routes were eliminated, and many radial routes were combined into cross city routes. Network Direct was, however, also a severely constrained effort as it reflected the need to make significant cuts in service due to recession-era drops in patronage and subsidy.

Orbital bus routes are few and infrequent

Radial bus networks like Dublin's tend to develop in cities with strong centres. They are also a natural consequence of the outward growth of cities. When cities grow outward, the tendency is to extend existing transport routes to newly developed areas.

Radial networks tend to have weak orbital service, which is service that connects outlying or suburban areas to each other, bypassing the city centre.

As shown in the adjacent maps, this is also the case in Dublin, where there are relatively few orbital bus routes, and none of them are frequent outside the peak commute period.

NTA has previously undertaken studies of frequent orbital services; some of the ideas in those studies have been incorporated into the proposed network.





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The radial network was highly efficient, up to a point

A radial network, with the possibility of passenger interchange in the Centre, can be a very efficient way to distribute trips throughout a city. This is because:

- Radial routes generally follow the most concentrated paths of demand (suburb to City via suburban centres).
- When all routes meet in one central area, a passenger can travel from any point A to any point B with a single interchange.

This is most true in small and mid-size cities, and was true for most of the 20th century in Dublin. However, when an urban area expands beyond a certain size, radial networks start encountering a variety of issues:

- Radial routes get more distant from each other as they get farther from the city centre. In large cities like Dublin, this means that frequent bus routes are spaced too far apart to serve the middle of outer neighbourhoods.
- As new suburban centres develop, passengers on suburb-to-suburb trips must travel further and further out of direction through the city centre.
- The radial network of streets and roads that characterizes the city may not reach the farthest suburbs. Where the street network itself is not radial, it is hard to create and maintain efficient radial bus routes.

Two notable but problematic patterns of bus routing have arisen in the face of these issues: Orbital Compensation and Radial Distortion.

Orbital Compensation

Orbital compensation is a process of trying to use radial bus routes to serve places where the street pattern is more orbital than radial. There are many examples in Dublin, but here are two:

• In **Beaumont**, Routes 14 and 16 deviate through the middle of the neighbourhood, ensuring residents access to both Swords Road and Malahide Road. This makes both routes somewhat circuitous for traveling to points further out. (While Route 14 ends just beyond Beaumont, Route 16 proceeds all the way to the airport.)



• Multiple radial routes weave on and off of Ballymun Road to provide orbital access to Balbutcher Lane (Route 13), Finglas (Route 9) and Drumcondra Road (Routes 11 and 13).

Because service is spread out among multiple orbital movements, the frequency of the radial mainline service on Ballymun Road (Route 4) is limited to a bus every 15 minutes on weekdays, when the corridor as a whole might support service every 5 minutes, particularly if complemented by orbital services.

In each case, frequent orbital services, running east-west in these images, would not need to twist and turn as much as radials must do to serve the same areas.





Figure 62: Map of Routes 9, 11, and 13 near Ballymun Rd

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Radial Distortion

In most areas inside the M50, the arterial road network is oriented to draw traffic into and out of the city centre. This road network structure works well with the radial bus network structure.

In outer suburban areas, the street network operates differently, drawing traffic out of suburban neighbourhoods and onto motorways that eventually feed into the M50.

As a result, there are very few bus-operable roads connecting neighbourhoods. In some cases, there in fact are direct and deliberate obstructions to traffic from one neighbourhood to another, often meant to reduce "cut-through" car traffic.

This is a massive problem of linearity (see Chapter 2). When buses cannot run in straight lines, they must make long, frustrating and expensive deviations.

In addition, it is also in some cases an issue of permeability, where the road network is specifically designed to avoid connecting adjacent neighbourhoods to each other, preferring to connect them only to the nearest distributor road.

All this means the road network works against a radial bus network, because it forces radial routes to find circuitous paths to serve people. Circuitous paths make for longer travel, which reduces the attraction of public transport relative to other modes.

One approach to this problem is to focus more on connecting these areas to major suburban centres, on orbital routes or in a local feeder pattern, and then connect those centres to the city.

Some examples of this phenomenon in Dublin are the following:

• Blanchardstown: Routes 39 and **39a** travel from Ongar through most of the length of Blanchardstown in highly circuitous patterns, largely because the most direct paths between neighbourhoods are blocked to vehicular traffic.

Figure 64: Map of Routes 39 and 39a through Blanchardstown.



Figure 65: Map of Route 13 near Clondalkin

- Clondalkin: Frequent Route 13 takes a highly circuitous path through the highest demand areas, causing major delay to passengers further out. The less frequent Route 151 has a direct path on the new Nangor Road, but there is much less demand directly along this road, so it cannot support as high a frequency.
- Lucan/Ballyowen: Routes 25a/b deviate and split to reach all the areas in the vicinity of Grange Castle Road.
- Liffey Valley: As Route 40 • approaches Liffey Valley Shopping Centre from the east, it actually turns away from it to ensure service to Neilstown Road and Fonthill Road. This creates a frustrating journey to the shopping centre from the high-density areas just to the east, such as Ballyfermot.





BUS CONNECTS



Figure 66: Map of Routes 25a/b in Ballyowen, and Route 40 near Liffey Valley SC

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The radial network makes buses converge in the centre

The adjacent map displays the geographic pattern of bus volumes during the AM peak period³.

Because Dublin's bus network is so radial, bus routes converge on a limited number of key roads as they approach the city centre.

This pattern is even stronger in the city centre itself, where a very limited number of paths is available to traverse from north to south, or east to west.

Up to a certain point, this is a good thing, as the result is very high frequencies that are very attractive to customers.

But in some places, the bus volumes are so high, and the paths so constrained, that buses start being significantly delayed even in bus-only lanes, due in part to taxis but even to buses delaying other buses due to congestion.

Dublin's city centre will always be the convergence point of many extremely frequent public transport corridors, so ample bus-only facilities are needed, but it may be possible to more actively manage the volume of buses on critical segments.



BUS CONNECTS

³ A similar pattern prevails at other times, with less extreme contrasts.

Sometimes bus volumes converge to meet high demand

In many cases, convergence of multiple bus routes is positive and consistent with the overall demand pattern: demand for bus service is generally stronger in inner, denser neighbourhoods, so it helps for frequency to increase there. One example of bus volumes logically converging to provide super-frequent service to a high-demand area is from Rathmines Road to Aungier Street, as shown in the map below.

Figure 68: Map of bus routes and density of bus boardings in the Rathmines/Camden/Aungier corridor



Sometimes bus volumes converge through areas of very low demand

However, in other cases, the strong radial pull of the network forces large volumes of buses through areas that have no demand at all, or very low demand. In these cases, there is an imbalance between service frequency and demand in more central areas. Chapelizod Road is a clear example, as can be seen in the map below.

Figure 69: Map of bus routes and density of bus boardings on the Chapelizod Road and Chapelizod Bypass





4 STRUCTURE OF THE EXISTING BUS NETWOR

The existing cross city route pattern minimizes the need for interchange...

As in many cities, the Dublin network design includes many features designed to reduce the need to interchange.

This is most evident in the design of the cross city radial corridors. Major radial corridors are generally oriented to use multiple overlapping routes to:

- Distribute service to a broad fan of suburban areas on one side of the city.
- Extend through the city centre to serve multiple corridors on the other side.

Figure 70: Map of all-day routes on the Drumcondra Road corridor

Drumcondra Road and Malahide Road both present good examples. In both cases, multiple routes provide frequent service to a long segment, while routes fan out to provide broader coverage in outer neighbourhoods. At the same time, the routes on both corridors aim in different directions on their way south through the city centre.

This is portrayed in the maps below to the left (Drumcondra corridor) and to the right (Malahide corridor)

Dublin Bus does seek to offset timetables of overlapping routes to create the best possible combined frequency. This is a good practice, but there is no way to extend it to the patterns crossing the city centre – where short trips are most sensitive to frequency - because the overlapping routes that form each corridor are separating and recombining in this area.











...which makes the network very complex, and more difficult to use

The through-routing pattern described above means that it is possible to take a one-seat ride between numerous areas, minimizing the need for interchange. This is convenient for some users, but it comes at a cost:

- The line structure is necessarily complex and difficult to read, requiring many individual route and branch numbers to describe different levels of similarity and difference between routes.
- Because cross-city buses weave in all directions as they connect different corridors to each other, the city centre network is so complex that we have found no record to date of a map that successfully shows all the bus routings through central Dublin.
 - » The closest approximations focus either on (a) listing city centre stops where one can catch the bus to various suburbs, or (b) displaying the streets where buses operate, but focusing only on certain bus routes.
 - » For example, the adjacent image is a simplified map that shows only streets where the more frequent routes operate, but even so the visual complexity is overwhelming.
- This is not just a mapping issue, though. In a city with a large centre like Dublin, if a user cannot understand the network, they are likely dissuaded from using it between different parts of the city centre despite the high quantity of service.
 - » Easy legibility is crucial to attracting the occasional user who is not motivated to learn much complexity to make a desired and often spontaneous trip. This feature, routine in rail services, can also be brought to bus services through careful network design and branding, options explored in Chapter 5.

Fassaugh Cabra Road 7 ton (Fassaugh Mountjoy Avenue) Square Phibsboro **OO**Mater Road Mater Old Cabra Road 4 46a 120 83 Prussia Street 4 9 140 Stoneybatter 47911131 747 1 46a 120 122 140 46a O Parnell Square Parnell St Phoenix Park 40d 120 4 7 9 11 13 16 40 40d 46a 120 122 140 (Infirmary Road 83 and Zoo) O'Connell Street Blackhall 4 7 9 11 13 16 40 441 29a 41 Place Four 46a 122 123 140 747 Lwr Abbey St Museum Courts Jervis Abbey St Smithfield 25a 25b 39a 79 83 Kilmainham 25a 25b 397 -> 145 151 747 -> 14 15 27 79 151 S 145 747 25a 25b 79 83 145 747 27 70 161 25a 25b D'Olier/Westmoreland 145 747 79 145 747 479 11 13 14 47 Heuston 25a 25b 40 46a 👔 27 83 122 123 140 145 150 James's 4 7 11 14 Trinity ↓ 161 A 25a 25b 46a 140 145 13 40 123 Christchurch Inchicore 13 27 40 77a 123 150 151 Thomas 13 40 123 Street 11 14 15 25a 25b Fatima Suir 46a 140 145 Road St Stephen's 27 7 9 16 83 122 8 Idenbridge Green 150 151 Rialto 11 46a 145 Tram Stop Dolphin's ital Leeson Street The Coombe Barn Camden Harcourt Street

Figure 72: The map below shows the complex web of routes that cross Dublin City Centre. With an overwhelmingly complex city centre, even a map showing just a subset of routes is difficult to follow.





The fare structure reinforces avoidance of interchange

Even in cases where interchange might result in the most efficient trip, passengers are discouraged from changing buses by the price structure of public transport in Dublin.

This problem is not unique to the bus network, but affects Luas and Irish Rail as well. The following are examples of price challenges inherent to interchange:

- It is always more expensive to use a second mode (bus-torail, or rail-to-bus), even when it saves time or results in a shorter journey.
- Unless one holds a Taxsaver pass or comparable discounted pass, it is also always more expensive to board a second bus.
- When paying with a Leap card, an interchange results in a 1 euro discount on the second fare, but only if taken within 90 minutes of the initial boarding.
- The daily cap available on the Leap card is 7 euro if one uses only the bus in a given day, but rises to 10 euro if a rider switches between bus and rail at any point.
- In either case, the Leap daily cap is over 3 times the cost of a single boarding.
- Dublin Bus, Luas, and Irish Rail each have different weekly or monthly unlimited pass options, but no single operator's pass is transferable to any other operator.

Because the NTA is working on fare issues in parallel through the BusConnects plan, **the network plans explored in this study will presume that fare barriers to interchange can be removed**⁴, to illustrate the travel time benefits that arise when there are no added costs to the passenger due to changing between two public transport services.





⁴ As of October 2019, the NTA is studying the option to implement a 90-minute pass system on the Leap card. Passengers using the Leap card would pay the fare only on the first tap upon entering the first vehicle. Further taps upon interchange to a second vehicle would not result in additional fare.