System-wide Productivity

Some transit agencies and cities have adopted a goal of “maximizing ridership.” Implicit in this statement, however, is a constraint: there is a limit to how much funding is available to increase ridership. The transit agency cannot spend infinite amounts of money pursuing each additional rider in pursuit of “maximum” ridership.

The more specific way to state this goal, then, is “maximize ridership within a fixed budget.” Even if the budget grows, it is and will always be limited.

People who value the environmental, business or development benefits of transit will talk about ridership as the key to meeting their goals. However, because their transit agency is operating under a fixed budget, the measure they should be tracking is not sheer ridership but ridership relative to cost. They would not be satisfied simply by a large dot on the boardings map on page 58 until they knew what it cost the transit agency to achieve that large dot.

**Ridership relative to cost** is called “productivity.” In this report, productivity is measured as boardings per service hour.¹

\[
\text{Productivity} = \frac{\text{Ridership}}{\text{Cost}} = \frac{\text{Boardings}}{\text{Service Hours}}
\]

Productivity is strictly a measure of achievement towards a maximizing ridership. Services that are designed primarily for other goals, like providing lifeline access to those in need, will likely have low productivity. This does not mean that these services are failing or that the transit agency should cut them. It just means that their funding is not being spent to maximize ridership.

In 2017, an average of 38 people boarded a SEPTA bus for every hour of service provided. Figure 76 shows that the productivity of SEPTA has ranged from a high of 47 boardings per service hour in 2013 to a low of 38 in 2017. Productivity for SEPTA is higher than in Seattle, Denver, and Washington. But it is lower than in Boston and Los Angeles.

¹ The technical term for a service hour is “revenue hour of service,” which represents one hour of a bus and driver in operation, open to the public, accepting revenue. Revenue hours do not include the time drivers spend getting from the bus garage to the start of a route, which is known as deadhead. In this report we use the more intuitive term “service hour” instead of “revenue hour.”

Figure 76: Productivity: passenger boardings by bus per service hour for SEPTA and peers, 2007–2017. Flat investment and declining ridership has led to declining productivity since 2013.
System-wide Coverage

The non-ridership benefits of transit arise from coverage of residents, jobs, services, geographic areas, or key groups of people. Transit that serves a coverage purpose is providing access regardless of whether or not it results in ridership.

One simplified way this can be measured is by drawing a fixed-width buffer around the transit network, and measuring what is in the buffer. The width of the buffer is always difficult to decide upon—will people walk 1/4 mile to transit? 1/2 mile? More? Everyone is different, and some people will walk far while others will not or cannot walk at all. People will generally walk farther to better service, so the best assumption of walking distance relates to the service in question.

However, every place in a city is different; 1/4 mile in one area may be easy but simply crossing the street in another place is terrifying or impossible. When street grids are disconnected, and cities are divided by barriers like freeways, people can be a short distance by air from a transit stop but a long distance by foot.

Figure 77 reports how well the SEPTA network is covering residents and jobs in the City of Philadelphia. The analysis shows the percentage of people and jobs within 1/4 mile and 1/2 mile of any service. This analysis assumes that everything beyond a 1/2 mile of a transit route is inaccessible from the transit route, though that assumption will be too low for some people.

This analysis also shows how many people and jobs are covered with frequent service (a bus or train coming every 15 minutes at midday).

Nearly all people and jobs in Philadelphia are within 1/2 mile of any service. About 91% of people have access to frequent service at midday. This number cannot be expected to be 100%, because some corners of the city are extremely expensive to serve due to low density and geographical barriers.

Non-white residents have slightly better access to frequent service compared to all residents in the city. This is because most non-white residents live in higher density areas that are naturally easy to serve with frequent service. Similarly, residents in poverty have slightly better access to frequent service because most live in higher density areas than residents who are not in poverty.

Figure 77: People and jobs covered by transit in Philadelphia—most residents have access to some transit.
The Grid Network

Most of the City of Philadelphia is covered by the public transit network and that network is primarily arranged as a grid.

The grid pattern is most obvious in South Philadelphia (see Figure 79), where north–south routes like 7, 17, 2, 45, 47 and 57 intersect at regular distances with the primarily east–west routes 40, 64, 29, 79 and G. The central spine for north–south service in the city is the Broad Street Line and the central spine for east–west travel in Center City and West Philadelphia is the Market-Frankford Line.

A grid network is one of the most efficient ways to provide liberating transit service across the whole city because it provides a one-transfer trip between any two points along the network (see Figure 78).

Of course, the SEPTA network is not a complete grid, and there are plenty of obstacles that prevent the grid from connecting every part of the city with just one transfer. West Philadelphia is partially cut-off from the rest of the city by the Schuylkill River.

The network in West Philadelphia has characteristics of both a radial network and a grid network. The trolley lines radiate from Center City from the east–west axis provided by the Market-Frankford Line. Other bus routes, like Routes 30, 32, and 42, provide radial service from Center City to West Philadelphia. Within West Philadelphia, north–south bus routes, like Route 52, provide crosstown service that creates a hybrid radial-grid network, also called a polar grid or spiderweb grid. Figure 80 shows the difference between a pure radial and pure grid network connections.

Some bus routes provide direct access from West Philadelphia to North or South Philadelphia without going downtown. For example, as shown in Figure 81, Routes 64 and G connect from West Philadelphia to South Philadelphia.

Radial Network
Most routes lead to and from downtown. Anyone wishing to travel from one non-central location to another must pass through downtown and transfer to another route there.

Often, routes are scheduled to converge at a set time (called a “pulse”) to reduce transfer times between routes.

Grid Network
Parallel east–west routes and parallel north–south routes intersect all across the city, not only downtown.

Grid networks are only effective when intersecting routes operate at high frequencies, generally every 15 minutes or better, so that connections between routes do not require long, inconvenient waits.

Figure 78: A grid network provides a one-transfer trip between any two points.

Figure 79: A grid network covers South Philadelphia with consistent north–south and east–west routes creating easy connections.

Figure 80: Comparison of radial and grid network structures.

Figure 81: West Philadelphia has both radial and grid elements.
Transfers or Connections

The value of a grid network is unlocked by the ease of transfers, or connections, between routes. Philadelphians are making the most of the frequent grid as evidenced by the large number of boardings at grid intersections. The transfer activity is clear in the map of boardings on page 58.

A clear example of the high transfer activity is where Routes 47 and 60 cross at 5th/6th Streets and Allegheny Avenue in the Fairhill neighborhood, shown in Figure 82. Both routes provide frequent service during the peak and midday periods.

The pattern of boarding activity in the area is shown in Figure 83. Clearly there are larger dots at the stops near where the two routes cross, indicating more people are boarding at these stops than at nearby stops.

This pattern could reflect different land uses. Yet, Figure 84 shows the pattern of land use at the intersection of 5th/6th and Allegheny is not more dense than the surrounding area. Also, with the railroad crossing underneath this area and vacant lots around these intersections, the density is actually somewhat lower at these intersections than around nearby stops.

Thus, people are clearly responding to the value of frequent grid connections to make transfers between frequent routes in the SEPTA bus network.

Figure 82: Routes 47 and 60 cross in North Philadelphia (in circle)
Figure 83: Boarding activity where Routes 47 and 60 cross (in circle)
Figure 84: Aerial imagery where Routes 47 and 60 cross
Barriers to Connections

The cost of transfers is a barrier to passengers making these connections. The current SEPTA fare structure has a substantial transfer fee for people who pay with cash or a token. Currently, the base cash fare for riding a bus, trolley, or MFL in Philadelphia is $2.50. A token reduces this cost to $2. But for passengers using either cash or a token, a transfer must be purchased at the start of their trip for an additional $1. A second transfer can also be purchased for an additional $1 for a total cash fare of $4.50. Paying with a token would reduce this cost to $4.

Recently, SEPTA has introduced the SEPTA Key fare payment system. With the new Key card, a rider can tap the farebox to pay using a pre-purchased daily, weekly, or monthly pass stored on the card or use dollar value that is stored on the card as a “Travel Wallet.” When paying with the travel wallet function, riders pay the token price ($2 base fare and $1 transfer). Once Key is fully implemented, riders will no longer be able to pay cash for a paper transfer. Instead, riders paying cash will have to pay full price for each leg of their trip.

Most riders use a pass or are seniors (who ride for free per state policy) and are therefore not deterred from transferring. Figure 85 shows that in Fiscal Year 2017, 64% of riders were pass users or seniors while 32% of riders paid cash or used tokens and, if they wanted to transfer, needed to purchase a paper transfer.

The transfer fee affects how SEPTA plans and manages its network as well. Because 32% of riders pay cash or use tokens, and are therefore penalized for transferring, these riders will tend to lobby for routes that minimize transfers—even when more frequent service with an easy connection would provide better access to more people and jobs.

The hassle of paid transfers is, aside from the financial costs, a deterrent to seamless connections between routes in an efficient grid network and reduces the convenience for customers. The industry standard is for the base fare to include 90 to 120 minutes of riding anywhere in the system. Los Angeles, for example, has a $1.75 base fare that allows a complete one-way trip within a two-hour window if the passenger is using a TAP card (which is a reloadable, stored-value fare card like the SEPTA Key Card). Riders who pay cash in Los Angeles do not get the benefit of a free transfer. New York City Transit has a $2.75 base fare that allows for one or two transfers in a two hour window when using a MetroCard.

The additional cost of a transfer prevents many riders from reaping the full benefits of SEPTA’s useful grid network and it is encouraging riders and others to demand duplicative route designs that maximize one-seat rides.

The experience of Metro in Los Angeles is probably the most comparable to SEPTA. Both agencies cover a large region. And until 2014 both agencies charged for a transfer. Prior to 2014, Metro charged full fare for any transfer. Therefore a two seat trip would cost $3.00 (twice the $1.50 base fare). In May 2014, the Metro Board approved an increase in the base fare to $1.75 while providing for free transfers when using a TAP card.

Since SEPTA is already phasing out paper transfers with full implementation of the SEPTA Key card, it is already implementing part of the same policy that Los Angeles Metro implemented during its transition to free transfers. An increase to the base fare, coupled with free transfers when using a SEPTA Key card would be a similar approach to how Los Angeles Metro managed the transition.

Some riders would be negatively affected by this kind of change. Riders who only take a one-seat ride fewer than eight times per week (and therefore would not benefit from a discounted pass product) would pay more for each trip. Figure 86 shows SEPTA Key data from April 2017. Among pass users, about 32% of trips include a transfer. But for Travel Wallet users, only about 14% of trips include a transfer, suggesting that many of these riders are trying to minimize their costs by not paying for a transfer or a pass.

Yet even these users would likely see benefit from the removal of the transfer penalty alongside a network redesign. By reallocating duplicative service, some of which is requested because of the transfer fee, SEPTA could increase frequency on routes that serve more people, which would improve service for many riders who do not transfer today or in the future.
Duplicative Network Design

Route 1 is an excellent example of the challenges of network design in a grid structure when the fare system encourages one-seat rides. Route 1 starts in West Philadelphia at City Avenue and 54th Street. It travels in a northeasterly direction along US Route 1 (City Avenue and then Roosevelt Boulevard) to the Parx Casino in Bucks County, just beyond the city line.

Along its way, Route 1 duplicates portions of Routes 65, 44, 61, R, 14, 20, and 50. Route 50 provides higher frequency service to the Parx Casino out of Frankford Transportation Center at the end of the MFL. The only section of the city where Route 1 provides unique coverage is along the short stretch of Roosevelt Boulevard between Pratt and Bustleton. But even in this area, numerous other routes, like Routes 19, 59, and 67, provide service to this area.

The pattern of boarding activity shows that many people are boarding east of the Schuylkill River. There is a moderate boarding dot at the Hunting Park Station on the Broad Street Line. The section of Roosevelt Boulevard and Hunting Park Station are already covered by the frequent Route R, as seen in the top panel of Figure 87. At Frankford Transportation Center, Route R connects to Route 50, which runs every 30 minutes and serves the same destinations in Northeast Philadelphia as Route 1, as seen in the bottom left panel of Figure 87.

Cutting Route 1 would leave people along City Avenue with a much longer ride to destinations in Northeast Philadelphia. But there are relatively few people making this entire trip. And their situation could be partially addressed with higher frequency service on Route 50. This would also expand the overall access for more people as Route 50 provides more unique coverage than Route 1. Moreover, it would be possible to maintain a two-seat ride connection from West Philadelphia to Northeast Philadelphia by extending Route R from Wissahickon to City Avenue and 54th.

Figure 87: Route 1 duplicates service provided by many other routes and therefore has relatively few boardings.
Inconsistent Route Spacing

In most of South, Central, and North Philadelphia, the spacing between north-south and east-west routes is inconsistent. In this area, north-south running routes are spaced about 1/4 mile apart, but most east-west running routes are spaced about 1/2 mile apart (see Figure 88). This small distance between north-south running routes makes for very short walking distances, generally less than 1/8 of a mile in South Philadelphia, to reach a transit line. For many people in this part of Philadelphia who are willing to walk there are three bus routes within a 1/4 mile walk: two north-south routes and one east-west route.

Inconsistency in the spacing of routes shows up in the productivity of Route 2. For lower frequency routes, like Route 2, people who prefer less waiting over more walking will walk to either the Broad Street Line or Route 17 to reach frequent service. And thus the productivity of Route 2 is lower than even Route 7, which has lower frequency but less competition from higher frequency service.

Figure 89 shows the pattern of boardings in South Philadelphia, including on Route 2. The large dots along Broad Street represent passengers coming off the BSL and boarding buses near the stations. Thus the BSL stations stand out strongly on this map.

Boardings on the northbound Route 2 tend to be smallest as the route nears the BSL stations and largest at the point where the route is farthest from a BSL station or a crosstown route. This pattern is partially hidden by the pattern of larger dots where Route 2 crosses east-west routes like Routes 29 and 64. At these locations the dots are larger as riders transfer to and from Route 2. But in the circled section in Figure 89, there is a consistent pattern of smaller dots near the cross streets of Oregon, Snyder, and Washington, where there is easier and closer access to a BSL station or frequent east-west crosstown service. The pattern of boarding activity and route productivity is clearly showing that many people prefer to walk to higher frequency service.

Figure 89 shows the pattern of boardings in South Philadelphia, including on Route 2. The large dots along Broad Street represent passengers coming off the BSL and boarding buses near the stations. Thus the BSL stations stand out strongly on this map.

A more consistent route spacing in South and North Philadelphia would provide service in each direction at 1/2 mile intervals, resulting in a maximum walk of about 1/4 mile to any transit service. Savings from consolidation of service could go to increasing frequency so that Routes 40, 64, and other lower frequency routes could be run at 15 minutes or better, creating a complete high frequency grid for this part of the city.

Bus Stop Spacing

Philadelphia bus routes typically have stops roughly every 500 feet, or ten stops per mile. For example, a typical east-west route will stop at 1,500 feet, or two to three typical Philadelphia blocks. Many transit agencies are studying stop-spacing and developing consistent city-wide policies, usually in that range.

A 1,000 foot or two block spacing would mean that:

- Buses run noticeably faster, because customers gather at fewer stops where they can board more quickly. We estimate a 2% speed increase on segments without stop signs. This is a conservative estimate compared to recent experience with the Route 47 stop consolidation pilot.
- Everyone is still within a short walk of one bus stop, but not necessarily two consecutive stops. Of course, riders only need to reach one stop, not two.
- Fewer parking spaces are removed to accommodate bus stops, although those that remain will need stronger enforcement.

Stronger enforcement of parking restrictions at bus stops is a key part of the partnership between the City and SEPTA. It would lead to fewer disruptions and delays, increasing the speed and reliability of service.

East–west routes through Center City, North, and South Philadelphia would likely see the greatest benefit from spreading stops farther apart as most east–west routes are on streets that primarily have signals instead of all-way stop signs. Among north-south routes, 33 and 57 have the most traffic signals along their paths and would likely see the greatest speed improvements from wider stop spacing.
Transfer Fees Encourage Longer Routes

When SEPTA charges for transfers, riders will naturally respond by asking for long routes, to minimize their own costs. SEPTA, as an operator, naturally wants to design routes that have a reasonable chance to operate reliably, which argues for shorter routes. Therefore, there is a natural tension between longer routes that maximize mobility and minimize transfers versus shorter routes that improve reliability. This tension is demonstrated in the dynamics around Route 23.

Although Route 23 is highly productive, it is very long. Very long routes are more susceptible to reliability problems from congestion and other unexpected disruptions. In 2015, Route 45 was split off from Route 23 to improve the reliability of both routes. To minimize disruption to customers, free transfers are allowed where these two routes overlapped within Center City from Locust Street to Vine Street. With this new configuration for Routes 23 and 45, twice as many buses are trying to navigate the most congested portion of the overlapping route segments in Center City.

Figure 90 shows the pattern of boardings on Route 23 and the graph in the lower section shows the pattern of boardings and alightings for southbound trips in the AM period. The graph shows that many passengers on southbound buses are alighting at Broad Street (indicated by the large bar point down at Broad Street). These riders are likely transferring to the BSL or a different bus route like the 4, 16, or 56.

If transfers were free, then it is likely that many more riders would choose to transfer here for the faster trip to Center City or other destinations afforded by the BSL. And, if transfers were free, it would allow SEPTA to consider alternatives to the current Route 23/Route 45 split, such as having the routes meet at Broad and Erie, without having to account for the negative impact to riders from a costly transfer.
Route 14 is an excellent example of this issue. Over the course of the day, Route 14 has 33 patterns. Figure 92 shows the schedule in the morning. Many routes in the SEPTA network have multiple complex patterns throughout the day [see Figure 91]. On average, routes in the SEPTA system have seven patterns per day. All of these patterns are arranged and communicated in a way that would take the route outside of the SEPTA network for short sections. The way these patterns are arranged and communicated leads to immensity confusion.

An unusual feature of the SEPTA network in routes that have multiple destinations and multiple paths between its origin and destination. A route should be easily understood by someone new to the city who reads the map and schedule. A route with too many patterns might be easier. To understand if it were split into two or more separate routes.

Figure 93: Map of Route 14. SEPTA routes are heavily utilized, as indicated by the dark gray.

Figure 94: Patterns by Route. SEPTA routes have numerous patterns. Many routes and routes hard to follow.
Route Productivity

The service hours provided on any particular route, and to any particular stop, will depend on a few factors:

- The length of the route.
- The operating speed of the bus (since a slower operating speed means that covering the same distance takes more time).
- The frequency of service along the route or to the stop (since higher frequency is supplied by more buses and operators out driving the route).
- The span of service along the route each day and each week.

Changing any of these factors for a transit route will affect the denominator of the productivity ratio. For example, doubling the frequency of service on a route will double the denominator, number of service hours being supplied. We might therefore expect that productivity of the route would be cut in half unless boardings, the numerator of the productivity ratio also increases.

The plot at right shows the individual routes from SEPTA, each plotted according to their midday frequency (on the horizontal axis) and their productivity (on the vertical axis).

The data points form a curve, up and to the left. More frequent services tend to have higher productivity (ridership per service hour), even though providing high frequency requires spending more service hours. (This is true not only in Philadelphia but also all over the world.)

The routes in Figure 94 are color coded by groups depending on what kind of service they provide. For example, red dots indicate routes that primarily run north–south through Center City. Since there are so many routes that serve a variety of different roles in the SEPTA system, route productivity is analyzed by group in the following pages, with emphasis on routes that are outliers.

Figure 94: Frequency is correlated with productivity on SEPTA bus routes and different route types have different productivity.
Productivity of North–South Routes

The performance of individual routes in the SEPTA system shows that the grid-oriented routes of the network are generally the strongest performing in the system.

Figure 95 shows the productivity of north–south oriented routes that serve Center City. Many of these are the highest ridership routes in the SEPTA system and many are quite long as they traverse most of the city from north to south. Routes 23 and 47, for example, are each about 10 miles long which makes a round trip over 20 miles. These routes generally achieve high productivity, with most getting more than 40 boardings per hour.

The low performing outliers can all be explained by poor geometry or competition from adjacent routes. Figure 96 highlights these outlier routes and their differences compared to the other routes is clear. Both Routes 25 and 32 suffer from being adjacent to undeveloped areas. In the case of Route 25, most of the area east of the route is the Delaware River. For route 32, most of the area west of the Route is parkland or the Schuylkill River. Therefore, the catchment area of both routes is only about half-filled. In addition, Route 32 duplicates other, higher frequency routes south of Girard, where it runs along the same streets or within a few blocks of Route 48 or 38.

Route 5 runs very close to the Market-Frankford Line. South of Girard, Route 5 is between the MFL and the higher frequency Route 57. It provides important coverage for the busy Frankford corridor where the MFL is on Kensington, but Route 5 will naturally get lower ridership as those willing to walk will prefer to go to the more frequent and faster service provided by the MFL.

Route 61 is unique among the north–south routes in that it runs diagonally across North Philadelphia along Ridge Avenue. It provides duplicate coverage of many other higher frequency routes.

Route 61 does provides a one-seat ride from Wissahickon and Manayunk to Center City. However, the value of this service is less useful because Regional Rail service on the Manayunk/ Norristown Line provides a similar one-seat ride that is faster, though at a higher fare and a lower frequency of service. Regional rail provides a 17 minute ride from Wissahickon to Jefferson Station compared to a nearly 50 minute ride on Route 61.

Figure 95: Some north–south routes serving Center City have relatively low productivity.

Figure 96: Routes 5, 25, 61 and 32 compete with higher frequency routes for riders and rarely provide unique coverage.
Productivity of East–West Routes

Figure 97 shows the productivity of the east–west oriented routes that serve Center City. Many of these routes are trolleys from West Philadelphia. In general, the productivity of these routes is higher than the north–south oriented routes shown in Figure 95. This is likely because the east–west routes are generally shorter and because the activity density of West Philadelphia is higher all the way to the city line.

Route 30 stands out as a high-productivity route at a relatively low frequency-of-service. This route serves the Haverford Avenue corridor but has a large deviation to serve the major hospitals in University City before terminating at 30th Street Station. In this deviation Route 30 is largely duplicating the LUCY (Loop Through University City) Green and the Gold Shuttles. A major reason for needing this deviation, though is that the LUCY shuttles do not run on weekends.

Another unusual feature of the West Philadelphia transit network is the complexity of routing through Mantua, the area north of University City. Route 31, which primarily serves as a local bus route under the Mantua neighborhood before going back to Market Street to go to Center City. Route 43 crosses Route 31 and serves the neighborhood on its way from Parkside Shopping Center to Center City.

Route 38, which comes from the north via Belmont turns down Parkside, then 40th, then Mantua before crossing the river via Spring Garden. By running on Mantua Avenue, Route 38 has limited coverage because the railroad corridor north of the street is a major a barrier for pedestrians. The only destination that Route 38 might serve north of the railroad is the Philadelphia Zoo, which is landlocked between railroads and the Schuylkill Expressway.

In addition to these four bus routes that traverse the heart of the neighborhood, the Route 10 trolley line provides high-frequency service along the south edge of the neighborhood along Lancaster.

Overall, this pattern spreads service across many streets in Mantua in a manner that tends to minimize walking distance while requiring longer waits.

Figure 97: Most east-west routes serving Center City have high productivity.
Productivity of Crosstown Routes

Crosstown routes include routes in three general groups:

- The shorter east–west cross town routes in North and South Philadelphia, like Routes 29 and 60.
- The shorter north–south crosstown routes of West Philadelphia, like Routes 52 and 46.
- The longer, orbital-style routes that serve areas on both sides of the Schuylkill River, like Routes 43, G, and 65.

Many of these routes are short. Short routes through high density areas tend to achieve higher productivity because each bus is making more trips each day and passengers are getting on and off more regularly than on longer routes. We call this phenomenon a high turnover rate.

The high productivity of crosstown routes is closely tied to transfers to grid and radial routes that take passengers to Center City and other destinations throughout the city and region.

The two lowest productivity outliers among the crosstown routes are Routes 1 and 77. Route 77 is the farthest north crosstown, traversing Montgomery County and on to Germantown frequency and low-density area, it is understandably a low-productivity route. Route 1, however, traverses a corridor with much higher densities. It operates at a fairly low frequency and, as discussed on page 72, it duplicates coverage of many other routes with much higher frequency.

Figure 99: Most crosstown routes have high productivity.
Productivity of BSL Connector Routes

In North Philadelphia, eight routes serve primarily as feeder routes to the Broad Street Line at its two most northern stations (Olney and Fern Rock). Routes 6, 18, H, and XH are generally short. And shorter routes with high turnover tend to achieve very high productivity.

The main low-productivity outliers are Routes 28 and 55. Route 28 is a long, L-shaped route that runs across Northeast Philadelphia on Cottman Avenue, through Jenkintown, and then south to Fern Rock. Thus, it is serving two purposes as a crosstown for Northeast Philadelphia and as a BSL feeder. Route 55 is a long feeder route that primarily serves lower density areas in Montgomery County.
Productivity of MFL Connector Routes

In Northeast Philadelphia, numerous routes provide connectivity to the Market-Frankford line and other north–south and crosstown routes in the area. Figure 102 shows the productivity by frequency of these routes. Route 66 stands out as the most productive of this group at nearly 60 boardings per hour. The remaining routes all achieve less than 40 boardings per hour.

The productivity of routes in this part of Philadelphia is naturally lower because much of the covered territory has lower density than the rest of the city. In addition, many routes in Northeast Philadelphia are trying to be both radial and crosstown to provide service that terminates at Frankford Transportation Center.

Figure 102: Most MFL Connector routes have relatively low productivity.

Figure 103 shows how the network in Northeast Philadelphia begins to shift away from the simple grid network toward a more complex radial network. Roads like Roosevelt Boulevard form diagonals across the grid. Pennypack Creek creates a major barrier that prevents direct, linear routes from connecting this part of the city.

In addition, the terminals of the BSL and MFL create natural radial connections for bus routes to funnel people into the much faster subway and elevated rail network.

Figure 103: The road and transit network transitions to a more radial system in Northeast Philadelphia.
Productivity of Express Routes

Three express routes (9, 27, and 44) provide one-seat rides from Northwest Philadelphia and Montgomery County to Center City via the Schuylkill Expressway. These three routes are among the lowest productivity routes in the network.

Route 27, in particular, has the lowest productivity. It serves more residential areas with less activity along Henry Avenue. While it continues out to Plymouth Meeting Mall, it serves less two-way demand than other routes. Figure 105 shows the pattern of boardings by time of day on Route 27 and they are much higher in the peak direction (southbound in the morning and northbound in the afternoon). Thus most buses in the off-peak direction are carrying relatively few passengers compared to other routes.

Given the low productivity of these routes, a key question would be whether this demand could be served with connections to Regional Rail or to the BSL or MFL. Overall trip times to Center City might be a little longer, but the resources expended to run buses all the way to Center City could provide more frequent service that connects to local destinations and nearby rail stations, providing more useful service for a greater variety of trips.
Regional Rail Integration

The example of Route 61 raises the critical question of the role that Regional Rail service might play within the City of Philadelphia. For areas of Northeast and Northwest Philadelphia, Regional Rail provides the fastest service to Center City and could play a larger role in serving the needs of city residents. With better connections between Regional Rail and the rest of the SEPTA system at stations like North Philadelphia, the Regional Rail network could provide more mobility within the city.

Two major barriers prevent Regional Rail from playing a larger role. One is the frequency of service. Figure 106 shows the midday headways for the regional rail lines in the city. Most lines have hourly frequency, which is worse than most bus service in the outer areas of the city. Worse, the frequency of service is irregular and passengers must refer to timetables because the service patterns are complex.

For example, during the midday at Wissahickon, inbound trains arrive at 10:23 am, 11:21 am, 12:24 am, 1:17 pm, and 2:19 pm. Consistent headways, even if they are long, would make it easier for riders to understand Regional Rail, remember the schedule, and make it a more useful option.

The other major barrier is the higher fare. Regional Rail fares are distance based using a zone system. Within the city most stations are within Zones 1 and 2 and single ride tickets (purchased prior to boarding) are $5.25 during the day on weekdays or $4.25 on weekday evenings (after 7 pm) or weekends. The fare for travel to intermediate stations without going through Center City is only $3.75. Tickets purchased on the train cost $0.25-0.75 more.

Numerous barriers prevent the simplification of Regional Rail schedules to provide consistent headways and to integrate fares. Some of these obstacles are organizational, some are financial, and others are the result of infrastructure limitations. A detailed study of those obstacles is beyond this study’s scope, but better integration of Regional Rail with the rest of the transit network presents an opportunity to increase the access and mobility of city and regional residents.

Better integration would likely result in more use of Regional Rail for reverse commute trips. Today, Regional Rail is primarily used for commuters coming to Center City to work. Increasing the use of Regional Rail for reverse commuters going to suburban jobs or for other trips would use excess capacity and likely increase Regional Rail productivity.
Responding to Specialized Demands

Route 47M is the lowest performer among the north–south routes shown in Figure 95 on page 77. This is a highly specialized route that primarily serves the Italian Market on 9th Street. Until 1993, SEPTA operated all Route 47 buses via 9th Street, but the busy Italian Market meant that many buses were stuck in traffic during their trip through South Philadelphia. In May 1993, northbound Route 47 was shifted to 7th Street to improve speed and reliability. But the 47M was also added to maintain service on 9th Street.

Route 47M operates northbound only and is effectively using one bus from the northbound 47 every 20 minutes to run through the Italian Market on 9th Street. This is done so that people going to the market do not have to walk two blocks from 7th Street to 9th Street.

This kind of response to specialized demands takes frequency from the most productive north–south route to reduce walking distance for a few people. And very few people are using Route 47M to get to the Italian Market. Figure 108 shows the pattern of people who board and alight on the route. Most people riding Route 47M get off at Market Street. Very few riders are getting off at the Italian Market between Washington Avenue and South Street.

The impetus behind Route 47M is similar to that behind the inconsistent route spacing. Both approaches are trying to minimize walking distance for a few people at the expense of higher frequency service for the large numbers of people who value shorter wait times.

Figure 108: The pattern of boardings and alightings shows that most people who ride Route 47M are going to Market Street, not the Italian Market.

Figure 107: Routes 47M takes frequency from northbound service on 7th Street to reduce walking distance to destinations on 9th Street.
Circuitous Routing to Minimize Transfers

The most circuitous route in Philadelphia is one of the least productive. This is not surprising, as most people want to travel in reasonably straight lines.

Route 89 in the Kensington and River Ward neighborhoods snakes around from the York-Dauphin MFL station through Port Richmond then north through Harrowgate. It then turns south and connects to two MFL stations on Frankford before turning north to connect to St. Christopher’s Hospital and Juniata before finally turning back east to terminate at the Arrott MFL station. The route and its pattern of boardings and alightings is shown in Figure 109.

The route provides segments of useful and unique coverage. For example it covers the section of Hunting Park west of Castor and provides direct service to St. Christopher’s Hospital.

Route 89 is trying to connect many places to be useful to many people, but it does so in an indirect manner to avoid asking people to transfer. For example, this route provides a one-seat ride for many people in the Juniata, Harrowgate, and Port Richmond neighborhoods to the Walmart at the Aramingo Crossing Shopping Center. But many people in these areas could probably make this trip faster by walking to Routes 75, 56, or 60 and connecting to Route 5, since all run at higher frequency than Route 89.

Also, to make this one-seat ride possible, Route 89 must turn back on itself at Frankford Avenue, creating a significant duplication of service. It also ends up duplicating large sections of Route 25 in Port Richmond.

Route 89 is circuitous and specialized. It is heavily focused on a narrow market, instead of being designed to be part of a network that many people will find useful for a range of trip purposes.

A redesign would look closely at circuitous routes to see if there are ways to make parts of them straighter and better connected to the larger network so they would appeal to a broader market.

Figure 109: Route 89 is an example of a highly circuitous route. The map shows low average-weekday-boardings.
Legacy Elements

Part of the challenge for Route 89 and other routes in the Port Richmond and Juniata areas is that routes must contend with legacy network elements, some of which are very hard to change. Figure 110 shows the complexity of the network in this area.

Route 15B is the current bus replacement for the Route 15 trolley during PennDOT reconstruction of I-95. If Route 15 were not a trolley line, it would likely make sense to continue frequent service directly up Aramingo instead of staying closer to the river as the current and future route does.

Also, Route 25, which does follow Aramingo through the middle of Port Richmond, deviates south from Aramingo to Richmond Street at Castor Avenue. In doing so, it duplicates service provided by Route 73 on Richmond Street.

This deviation exists because years ago buses could not traverse Aramingo north of Butler due to the heavy industrial and freight rail activity in the area. Now, however, the area has redeveloped and by deviating at Castor, Route 25 misses serving the Aramingo Crossing Shopping Center.

Many routes in Philadelphia continue to make deviations and cover areas that do not make sense except for historical reasons. A network redesign would examine the purpose and need of all routes and coverage to remove these legacy elements and reallocate service across the entire network in ways that meet today’s needs.
Trolley Modernization: Opportunities and Challenges

The trolley network mostly provides direct access from West Philadelphia to downtown via a dedicated tunnel, which saves riders time relative to a surface trip along Market Street. SEPTA is currently studying a major modernization program for the trolley network to make significant improvements to the rails, stations, and signals and to procure new rail vehicles. Together, these improvements would increase capacity, improve reliability and make the trolley network more accessible to those with disabilities. These improvements would have benefits across the entire SEPTA transit network, since so many people transfer between trolleys and the rest of the network to make trips around the city.

Like most of the existing bus network, current trolley stops are about 500 feet apart. The requirements of the new platform stations (see Figure 112) means that stops will naturally have to be farther apart, if only because the infrastructure is so expensive. As described on page 38, best practice in stop spacing in dense walkable areas is to spread stops farther apart. A typical standard for frequent transit service is to space stops approximately 1,000 to 1,200 feet apart to best balance operating speed with the need to provide coverage and access to riders. It is also logical for stops to be closer together near the outer end of a trolley route, where fewer customers are riding through.

Planning is underway to site these new stops along the existing trolley lines. But the current urban fabric of West Philadelphia means siting these stations is a challenge.

New stations must be as close as possible to current crosstown bus routes. If stations are moved away from current crosstown bus routes, then these routes would have to be shifted to meet the new stations. This would lock in decades of excess operational costs for longer, more circuitous routes that increase travel times for customers.

Placing trolley stations adjacent to crosstown bus routes is imperative. A modest capital investment today will pay off for years to come in simpler and cheaper bus operations.

This major capital investment is an opportunity to consider many changes to increase the speed and reliability of trolley service, such as transit signal priority and dedicated lanes. The City and SEPTA can imagine the transit that West Philadelphia needs before compromising on design, to make major improvements in transit access and mobility with this modernization project.
The Girard Trolley: A Service or a Barrier?

Trolleys have a natural disadvantage compared to buses when running in mixed traffic: they cannot move around disruptions in the middle of the street. Because of this fundamental problem, trolleys without dedicated lanes are prone to much greater reliability problems than regular buses or rail with dedicated right-of-way. For the trolley routes that use the Center City tunnel (Routes 10, 11, 13, 34, and 36) this challenge is mitigated partially by having an underground dedicated right-of-way between University City and Center City.

Route 15 is unique, in that it does not use the Center City tunnel, and therefore does not get any advantage from being operated as a trolley versus a bus. In addition, the Trolley Modernization, which would introduce longer vehicles and provide disabled access, would require several expensive projects along Girard.

Most importantly, operating Route 15 as a trolley limits SEPTA’s ability to design the best possible network to maximize freedom and opportunity for the city’s transit customers.

This is a particular concern in West Philadelphia, where the current terminus of Route 15 is less than 2 miles from 69th Street Transportation Center. Extending the route to 69th Street as a trolley is very expensive. If Route 15 were a bus route, it would be easier to extend the route to 69th Street and provide a much faster and easier connection for many people in West and North Philadelphia to jobs and opportunities in Delaware County. Likewise, it would provide a much easier connection for people in Delaware County to destinations along Girard Avenue.

The east end of the line is less of a problem but also not ideal. For example a network design might find that a Girard service that did something different in the River Wards would yield better overall benefits.

The Trolley Modernization Project will likely require a change in the end of line for all trolley routes, including the Girard line, to accommodate the new, low-floor railcars. It may be possible, though unlikely, to retain the current end of line and accept poor access to parts of Delaware and Montgomery Counties, from points along Girard Avenue. If the end of line must be changed and the City and SEPTA want to retain the trolley on Girard, then the west end of the line should be extended to 69th Street Transportation Center, which would be an expensive extension. Alternatively, the line could be converted to a bus route, and if it is converted it should be extended to 69th Street.

If the City and SEPTA want to continue operating Route 15 as a trolley, then dedicated lanes and other protections are needed to protect this important, frequent service from unreliable mixed-traffic operations.

![Figure 113: Without dedicated lanes, trolleys are more susceptible to unreliable conditions on the road than buses.](image)

![Figure 114: As a trolley, Route 15 in West Philadelphia cannot reach 69th Street Transportation Center.](image)
**Peak Service**

For many people, an interest in transit arises mainly from the difficulty of commuting at typical “rush hour,” which transit planners call the peak. Transit agencies may also be expected to serve a school peak, which matches the commute peak in the morning but is 2 to 3 hours earlier in the afternoon.

In suburban areas, the peak pattern of demand is often radically different from the all-day pattern, and much more intense. In those contexts it often makes sense to run extensive services including entire bus routes only during the peak period.

However, peak-only service—which means running a bus or train for only 1 to 3 hours, carries several added costs for SEPTA that may not be apparent to the people who use it:

- Labor is more expensive because a driver cannot be expected to report to work for a shift of only two hours. Like most transit agencies SEPTA must pay a longer minimum shift time, making this service less efficient.
- Fleet costs are higher because a transit agency must own, store, and maintain a bus or train that is not being used very much.
- Peak-only demand is often one-way in nature—for example, into a downtown in the morning and out in the afternoon. This requires buses or trains to run empty in the reverse-peak direction, which is also a major expense.

Within dense cities like Philadelphia, the geographic pattern of demand is sufficiently constant that a network design that works for all-day also works for most peak demand. Therefore, there are not many peak only routes, but there are many routes where the frequency increases significantly at the peak. Since it costs much more to run these extra buses at the peak, they should only be run if they are achieving higher productivity.

Figure 115 shows the pattern of midday and peak productivity for routes in Philadelphia. There is a clear pattern where most routes have lower productivity in the peak than in the midday (routes in the orange section). This suggests that there is a “peak excess” in the system that could be redeployed toward more productive service. We estimate that this “peak excess” is at least 3% and likely 5% of total service hours.

Figure 115: Most routes have lower productivity in the peak than in the midday, suggesting excessive peak service.