More Service Without More Money: Strategies and Choices
What can be done to improve the design of Philadelphia’s bus network without spending more operating dollars? The question is really two questions.

1. **What can be done to improve the efficiency with which SEPTA provides useful service in the city, so that more useful service can be provided?** The following sections are about this question.

2. **What goals should be used in deploying service?** Here we must confront the trade-off between Ridership Goals (maximize ridership) and Coverage Goals (serve everyone). The last part of this chapter (page 95) is about this question.

### More Service without More Money

There are two important ways to create more useful service.

- **Remove inefficient services** so that service can be reallocated in more useful ways. Duplication includes any situation where routes or stops are too close together, so that passengers have two when they only need one. A related issue is excessive peak-only service, where too much service is added at rush hour relative to the actual demand.

- **Design for maximum connection opportunities**, so that services can be used for more purposes. Few people can expect a direct bus from their home to their destination. The key to an effective network is that every line connects with many others, so that by transferring between buses or trains customers can go anywhere.

The strategies outlined in this chapter all fall under one of these headings, as summarized in the table at right (Figure 116).

### How do we get more service without more money?

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<thead>
<tr>
<th>Strategy</th>
<th>Benefits</th>
<th>Downsides</th>
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<tbody>
<tr>
<td><strong>Strategies that Decrease Duplication and Excess Service</strong></td>
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</tr>
<tr>
<td>1. Remove Duplicative Route Segments</td>
<td>Resources can be reallocated to create more useful services.</td>
<td>More people have to transfer during their trip, but this does not mean total travel times are longer. Sometimes they are shorter due to less waiting.</td>
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<tr>
<td>2. Remove Excess Peak-Only Service</td>
<td>Resources can be reallocated to create more useful services. Peak-only service is especially expensive to run, so more resources are freed.</td>
<td>Minor, as this would only be done only where demand does not justify added peak service and frequency is high anyway.</td>
</tr>
<tr>
<td>3. Consistent Route Spacing</td>
<td>Avoids partial duplication where parallel routes serve the same area. Resources can be reallocated to create more useful services.</td>
<td>Longer walks to service are difficult for those who have difficulty walking.</td>
</tr>
<tr>
<td>4. Wider Stop Spacing</td>
<td>Increase average speed. Faster cycle time frees resources to create more useful services. Better infrastructure is possible at each stop.</td>
<td>Longer walks to service are difficult for those who have difficulty walking.</td>
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<tr>
<th>Strategy</th>
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<tr>
<td><strong>Strategies that Increase Connection Opportunities</strong></td>
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<tr>
<td>5. Remove Fare Penalty for Transfers</td>
<td>Encourages connections, which are the essence of an efficient network. The more connections a route makes, the more useful it is.</td>
<td>Would require review of fare structure. Could increase base fare.</td>
</tr>
<tr>
<td>6. Focus Service on Transportation Centers</td>
<td>Expands usefulness of all routes serving a transit center. Especially important for travel between City and suburban counties.</td>
<td>Transit Centers must accommodate more buses. In some cases this may require infrastructure.</td>
</tr>
<tr>
<td>7. Strengthen the Frequent Grid</td>
<td>The most efficient form of network for dense cities.</td>
<td>Frequency is expensive, so can be deployed only where many people will use it.</td>
</tr>
<tr>
<td>8. Link to Regional Rail Connections</td>
<td>Improved travel between city and suburban counties.</td>
<td>Difficult, due to low frequencies and irregular schedules of regional rail, but worth doing to extent possible.</td>
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Figure 116: Budget neutral strategies for increasing service.
Chapter 5 described some of the many places where SEPTA provides duplicative service. Duplication means that two bus routes run for a long distance on the same street, or on streets that are just a block apart, so that they are both competing for the same people going the same direction. Duplication, in effect, is competing with yourself.

If the two routes cooperate, then it is not a duplication. Sometimes two routes will run on the same street but their schedules will be offset to produce a higher combined frequency. For example, if two half-hourly routes ran down a street, but one left at .00 and .30 after the hour while the other left at .15 and .45, the two routes would combine to create a 15-minute frequency on their common segment. Even though there are two routes on the segment, this is not duplication, because the routes are working together to offer more service than either could alone.

Most Philadelphia duplications, however, are not like that. The result can be buses that are scheduled to run together for a long distance. Obviously, in this case, one bus could be doing the work of both, and the other bus could be redeployed to do something that no other bus is doing.

The main downside of reducing duplication is that it increases the need for some people to make connections—i.e., to get off of one bus or train and onto another. It is impossible, though, to run direct routes from everywhere to everywhere else. Connections—made as easy as possible—are already the principle on which much of the existing network is based, as we discuss below.

Exceptions can be made, of course, for very large destinations. Several bus lines run together along Market Street in Center City, and then disperse in different directions. In this case, a degree of duplication is tolerable in order to reach the major destination from more places. Still, duplication is expensive and effective networks do everything they can to minimize it.

As we discuss further below, about 10% of the existing bus service in Philadelphia could be classified as duplicative. This duplication is roughly equivalent to the cost to operate Routes 23, 45, 47, and 57, which are the most frequent north-south routes east of Broad Street. Redeploying this duplicative service is a key way to pay for major improvements in frequency or coverage in a redesigned network.

Chapter 5 noted that several routes have lower productivity (ridership / service quantity) during the peak than midday period. This generally means they are less crowded during the peak than the midday.

Service that runs for just a few hours in the peak periods is more expensive to operate than all day service, for two reasons:

- Drivers must be paid more to work very short or split shifts.
- Vehicles must be owned, stored, and maintained even though they are not used very much.

So peak service should be used more heavily than midday service to justify these costs. Where it is not, too much service is being added at the peak period, service that can be reallocated for more useful purposes. About 5% of the total service provided in Philadelphia consists of excess peak service.

Where parallel routes are very close together, they are partly duplicative. While they are not on the same street, they are competing for some of the same people—namely people who can walk easily to either route.

For this reason, an ideal spacing of parallel routes is about 1/2 mile, so that maximum walking distance to the route is about 1/4 mile.

The spacing of routes is sometimes much closer than this. For example, in South Philadelphia, north–south running routes are spaced about 1/4 mile apart, while most east–west running routes are spaced about every 1/2 mile apart (see Figure 117). 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 nearby transit lines.

The result of this pattern is that north–south lines, like Route 2, compete with the Broad Street Line (BSL) and Route 17. Many riders obviously prefer the faster trip on the more frequent Route 17 and the much faster trip on the more frequent and faster BSL.

More consistent route spacing—not just here, but in general—would provide service in each direction at closer to 1/2 mile intervals, resulting in a maximum walk of about 1/4 mile to a transit service going in the desired direction. This would free up resources for other purposes. Obviously, many local details prevent SEPTA from providing an exact 1/2 mile spacing, but this would be the principle. Half-mile route spacing is already the norm in many parts of Philadelphia, so it is reasonable to suggest it in other places.

The main downside from this change would be an increase in walking distance to access transit in some parts of the city. This would be an inconvenience to some, or a larger impediment to people who have a hard time walking, like seniors and people with disabilities. Also, as routes are spaced farther apart, transit becomes less useful for very short trips. So there would be compromises where ridership is very high, average trip distances are short, and senior and disabled populations are especially high.

Increases to route spacing are almost always compensated with higher frequency. As a result, the customer experience is often that they walk further to service that comes sooner, and their total trip is faster even accounting for the walk.
Consistent and Wider Stop Spacing

On many routes in Philadelphia, stops are extremely close together. For most people, it is easy to walk to any of several stops on a route. But a customer does not need several stops; they need one stop.

There is a geometric trade-off between closer stop spacing and faster bus speeds. Figure 118 shows the basic trade-off in conceptual terms. As stops are placed farther apart, buses can travel faster and cover more distance in the same time.

This is because most of the time required at a stop is not proportional to the number of passengers served. When there are many stops, passengers spread themselves out among them, so the bus stops more for the same number of people. When passengers gather at fewer stops, stopping time is used more efficiently, resulting in faster operations.

This increased speed has two benefits. First, riders can get farther faster and reach their destinations sooner. Also, as speeds increase across the entire transit system, more service can be provided for the same cost. Since the primary cost of transit service is the cost for labor which is paid based on time worked, the faster buses operate, the more service that can be provided for the same cost. So, higher frequency can be provided or routes can be extended to go farther for the same cost.

This is why standards for stop spacing in the US are generally in the range of 750 to 1,500 feet on high-frequency bus routes. By contrast, Philadelphia buses stop as little as 250 feet apart. Figure 119 shows the current stop spacing standards for SEPTA and four peer agencies. In general, SEPTA has the closest stop spacing standards.

There are two major downsides to this change. First, some people have difficulty walking and will be inconvenienced by a longer walk. Seniors and people with disabilities are more likely to feel inconvenienced by this change. Second, as stops are spaced farther apart, transit becomes less useful for very short trips. This is because walking distances at each end of the trip increase to the point that very short trips would be faster by walking or biking. Some cities and agencies view this as a good thing, arguing that the point of transit is to provide an alternative to driving, not an alternative to walking.

Obviously, the abundance of all-way stop signs on many Philadelphia streets means that the time savings of extending stop spacing would largely be lost if stop signs remained where bus stops were removed. This is an issue for further discussion with the City (see Chapter 3.) Philadelphia blocks are typically about 450 feet long. Widening stop spacing to every 2 blocks would result in stops about every 900 feet. Every 3 blocks would result in spacing of about every 1,400 feet, or a little more than 1/4 mile.

As always, the key to a successful revision of stop spacing is for it to be a consistent policy applied in all comparable circumstances across the city, and tied to a clear citywide benefit in travel times. Many transit agencies have successfully widened stop spacing where these benefits were clear.

Remove the Fare Penalty for Transfers

To encourage more efficient use of the SEPTA network, the fee for transferring from one bus or train to another needs to be removed. The cost of a trip should be the same regardless of the number of buses or trains required to complete it.

The most efficient and effective network is one in which passengers are encouraged to change buses as needed to reach their destinations most quickly. Removing duplicative services, for example, usually increases the need for people to change buses, but scarce resources are used more efficiently as a result.

Because changing buses is an activity that SEPTA needs to encourage, it makes no sense to charge extra for it. Airlines do not do this. In fact, flights requiring connections are often cheaper than direct flights.

While the financial and technical planning for this change is not included in this study, it is an essential element of creating a more useful network. Removing the transfer fee would have financial implications for SEPTA since the costs of passes are based on the cost of the base fare and a transfer. Many cities that have removed the transfer penalty have done so in conjunction with an increase in the base fare. This is often a reasonable compromise as now the base fare buys a rider more freedom and value. Of course, riders who only need one bus or train for their trip will not feel like they are getting more value.

Focus Service on Transportation Centers

The more routes connect with each other, the more trips are possible using them.

A network redesign process would be focused on improving the ways

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**Stop Spacing and Travel Times**

A trade-off exists between stop spacing and bus travel times. As stop placement widens, bus speeds and distance traveled increases. This trade-off allows quicker and more reliable service in exchange for asking passengers to walk to their nearest stop.

**Stop Spacing Standards for SEPTA and Peers**

<table>
<thead>
<tr>
<th>City (Agency)</th>
<th>Downtown</th>
<th>Urban</th>
<th>Suburban</th>
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<tbody>
<tr>
<td>Philadelphia (SEPTA)</td>
<td>500 ft (existing routes)</td>
<td>1,000 ft (new routes)</td>
<td>1,000 ft</td>
</tr>
<tr>
<td>New York (MTA Local Bus)</td>
<td>500–750 ft</td>
<td>600–1,200 ft</td>
<td>1,000–1,500 ft</td>
</tr>
<tr>
<td>San Francisco (MUNI)</td>
<td></td>
<td>800–1,360 ft</td>
<td></td>
</tr>
<tr>
<td>Boston (MBTA)</td>
<td>1,000–1,300 ft</td>
<td>750–1,300 ft</td>
<td>1,000–1,300 ft</td>
</tr>
<tr>
<td>Portland (TriMet)</td>
<td>780 ft</td>
<td>1,000 ft</td>
<td>As needed</td>
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routes connect. One method is the frequent grid, discussed below, which is the best solution across gridded and dense parts of the city. Around the edges, however, transportation centers play a critical role. Philadelphia’s main transportation centers are extremely well-located in the network. They tend to be at the edges of the dense, gridded area, at the point where development transitions from urban to suburban style. 1 As a result, transportation centers are ideal places for the routes of the urban frequent grid to end and for suburban routes to begin. By bringing many urban and suburban routes together at one point, these transit centers expand the ability of people to travel between various points in the dense urban area and various points in the suburbs.

The major transportation centers are even more effective when they have direct and frequent connections to each other. A network redesign process would focus on improving the frequency and directness of these connections.

Concentrating service on transportation centers may increase the volumes of buses that those facilities need to handle. A network redesign process will need to consider the constraints of the existing transportation centers as new or redesigned service is built into those centers.

Yet, the existing capacity of these centers should not determine the design of the network that uses them. In many cases, interim solutions could be devised to add new capacity that a redesigned network might require. And, capacity expansions at these facilities are often very good investments, as they increase the usefulness of service that already exists. In the long run, one-time capital expenditures can save money if they make better use of the never ending cost of operations.

### Strengthen the Frequent Grid

Most of Philadelphia is dense, walkable, and features a gridded network of streets. In this environment, the most efficient transit network is also a grid. While it makes sense for routes to converge on major destinations, a grid pattern of frequent lines is enormously powerful, because it means you can go from anywhere to anywhere in the grid area in an L-shaped trip with a single transfer.

The primary barrier to an effective grid is low-frequency service, because this means a long wait for the connecting bus or train. A frequency of 15 minutes is usually the worst at which a grid can function, and the payoffs of improving frequency further, to 10 minutes or better, are very high in terms of benefits to travel time.

Even where the street pattern does not permit a regular grid, effective planning looks for grid-like situations. In general, any situation where frequent routes cross is a place where useful connections can occur, expanding the usefulness of both of the routes involved.

### Integrate with Regional Rail

Serving regional rail stations has obvious benefits. For Philadelphia residents, this can improve access to suburban jobs. For suburban residents, these connections can improve access to destinations in Philadelphia other than downtown.

Unfortunately, making good connections between buses and regional rail is difficult, because:

- Regional rail is not frequent enough for connections to be easily timed. At most times of day, most lines run every 30-60 minutes. A frequent bus line connecting to regional rail will deliver a bus trip near when every train goes, but less frequent bus lines cannot do this, so long waits are likely at the train connections.
- Regional rail schedules do not follow a consistent pattern throughout the day. (A consistent pattern is one that repeats in every hour, e.g. “the train goes at :20 and :50 minutes after the hour.”) Because of this, infrequent bus routes cannot be consistently timed to meet every train in a regular pattern.
- Physical barriers between bus stops and rail stations are sometimes substantial. For example, Wissahickon’s rail and bus terminals are in different places with no provision for easy walks between them, and it is impossible to stop a bus adjacent to the rail station.
- A fare barrier between buses and regional rail continues to exist.

Regional rail was largely designed with a downtown-oriented market in mind, and with access assumed to be primarily by park-and-ride. As the city and region has evolved, these assumptions are becoming less relevant—especially as it applies to stations within Philadelphia. Many transit agencies in North America are studying their legacy commuter rail networks with a goal of making them more useful for two-way, all-day travel and for destinations other than the historic downtown. Such a study should be undertaken at SEPTA, but it is outside the scope of this report.

Still, a network redesign should consider regional rail service and do what it can, within these constraints, to improve connections between buses and regional rail at stations throughout Philadelphia.

### Focus on All-Day Markets First

As discussed in Chapter 5, peak service in Philadelphia tends to have higher costs than all-day service, yet the pattern of productivity shows that many routes have lower productivity at peak hours than during the midday. 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.

As a result, a network redesign would generally feature increased frequencies during the peak but few or no peak-only routes. Further, a network redesign would look closely at reducing frequency on the peak on routes where peak productivity is lower than midday productivity and redeploy those resources toward more productive uses.

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1 This transition zone between urban and suburban development types may not correspond to the city boundary. Philadelphia includes extensive areas built in a suburban style, especially in the northeast and northwest, while the dense urban development style sometimes extends into adjacent counties.

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Figure 120: A high-frequency grid provides convenient one-transfer connections between any two points.
The Ridership-Coverage Trade-off

High productivity (ridership / service cost) arises from running frequent service in places with favorable land-use conditions (dense, walkable, linear, etc.). Frequent routes connecting this kind of development are consistently SEPTA’s best performers while those with none of those features tend to be the worst. This pattern is common across most transit agencies.

It follows, then, that if the only goal of the system were to maximize ridership per unit of cost, SEPTA would focus its service on those transit-favorable corridors, maximizing frequency there, while offering less or no service to areas where the geographic conditions are less favorable. SEPTA could increase ridership at no new cost if it were to do this. We are not saying that SEPTA should do this, but a network redesign process would explore the outcomes that would be possible if it did.

The existing network, by contrast, shows a desire to run some service to all parts of the city, including to places where high ridership is not a realistic expectation, because the conditions that indicate high ridership potential are generally absent. Service to these areas is called Coverage service, because it is designed to cover the population with some service.

The balance of investment between high-ridership service and coverage service is a crucial question about how the community wishes to balance these competing values.

The Ridership goal tends to correlate with transit goals including:

- **Environmental**: Reduced vehicle trips and miles traveled (VMT). Empty buses do not displace vehicle trips.
- **Fiscal**: High ridership reduces subsidy per passenger due to higher fare revenue from the many passengers.
- **Urban Development**: Frequent service makes urban styles of high-density development more attractive and livable, and in some cities it is used to justify lower parking requirements for such development.
- **Social**: High ridership service efficiently meets the needs of most, but not all, disadvantaged people.

The competing goal of Coverage, however, also correlates with important goals. When people demand that service be available to “all,” the result is to spread service out.

- **Social**: Only coverage service can get to all disadvantaged people. (High-ridership service gets to most, but not all.)
- **Lifeline**: Some people have severe needs and would experience major disruption of their lives without bus service. This in itself is often a powerful argument for Coverage service.
- **Geographic or Jurisdictional Equity**: An expectation that transit should serve all council districts, or other electoral units, leads to Coverage service, because pure ridership-based planning would not be concerned with these boundaries.

The current balance between Ridership-justified service and Coverage-justified service did not arise from any policy, but evolved through a long series of service revisions. A network redesign process would help SEPTA and its stakeholders think about whether this balance is right, or whether it should be shifted.

In this imaginary town, you have 18 buses to run transit routes. How will you distribute your service?

If you concentrate service in the busiest areas, your routes are very frequent, so waits are short. You are maximizing total ridership, but some places have no service.

By covering all areas, routes are infrequent, requiring long waits, so very few people find them useful. Everyone has access to minimal service, but total ridership is low.

Figure 121: Ridership and coverage goals produce very different networks.

1 The terms Ridership and Coverage are capitalized when they refer to the two goals as defined here.
The existing balance of goals

In the current Philadelphia bus network, about 70% of the service runs in patterns that serve a Ridership Goal. About 15% are in patterns that effectively serve a Coverage Goal. Of the rest, about 10% is duplication and 5% is excess peak-only service.

There is no objectively right answer to the question of how much to pursue a Ridership Goal as opposed a Coverage Goal. The trade-off is about choosing between things that you like, just as you do in any budget process. This decision should arise from a public conversation.

Network Redesign Process

SEPTA should undertake a redesign study for the Philadelphia network, building on the analysis from this report. The study would:

- Develop multiple alternatives for what the network might look like, depending on different priorities that might be chosen. For example, one network alternative might focus more on Ridership, and the other on Coverage.
- Launch a major public conversation about these alternatives, to get feedback from citizens about what the priorities should be.
- Develop a draft recommended network based on the priorities that have been expressed.
- Conduct a second round of public conversation, to get public feedback on the draft recommendation.
- Revise the recommended network and implement it.

In parallel, similar studies should be undertaken for the four counties in the SEPTA service area.

Network Concepts

To help people see their choices and talk about them clearly, a network redesign study would create two alternatives for the network, one with a greater focus on the Ridership Goal, the other with greater focus on the Coverage Goal. Both would remove duplicative service and excess peak service, but they might differ on whether those resources are spent to improve ridership or improve coverage. Then, the community could think about where it wants to be in the triangle of Figure 123. This triangle shows the two questions that people would need to think about:

1. How much should the system change?
2. What should be the balance between Ridership and Coverage Goals?

The process to develop network concepts, and eventually a redesigned network, should not be solely a consultant recommendation. Instead, concepts and recommendations should be developed in a collaborative process with staff from SEPTA and the local jurisdiction planning and transportation staff.

What about the long term?

While this report is about the immediate redesign of the existing transit network, it can and should affect long-term planning of the city and its transit system.

Many areas of long-term improvement have been identified in this report and others are likely to be identified through a full network redesign. Some key areas for long-term improvements include: better integration with Regional Rail, transit priority on streets, and land-use policy coordination with high-frequency bus corridors.

A network redesign is one step in an iterative land use and transit planning conversation for the city, which can and should continue indefinitely, helping to build a more prosperous, fair, and livable Philadelphia.