

Assignment 1

Public Transit Fall 2020

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The Bus that Actually Comes on Time (BACON) of Greater New Brunswick

The governments of New Brunswick, North Brunswick, Highland Park, and Milltown have joined together to fund a new bus system to serve the four municipalities. The municipalities' goal is both to improve the overall quality of mass transit service for their residents and to serve particular locations that have been identified as priorities for improved service. In other words, the system will have to balance the desire for frequent service with the need to cover specific geographic areas, which might be difficult to serve efficiently.

Described below is a proposal for the system, which the municipalities have taken to calling The Bus that Actually Comes on Time, or BACON. The proposal uses the funding dedicated by the municipalities, matching funds from the state and federal government, and anticipated fare revenue to map out a 5-route system providing significantly expanded bus service on several major corridors, while also serving key destinations that do not lie on those corridors.

Route alignment

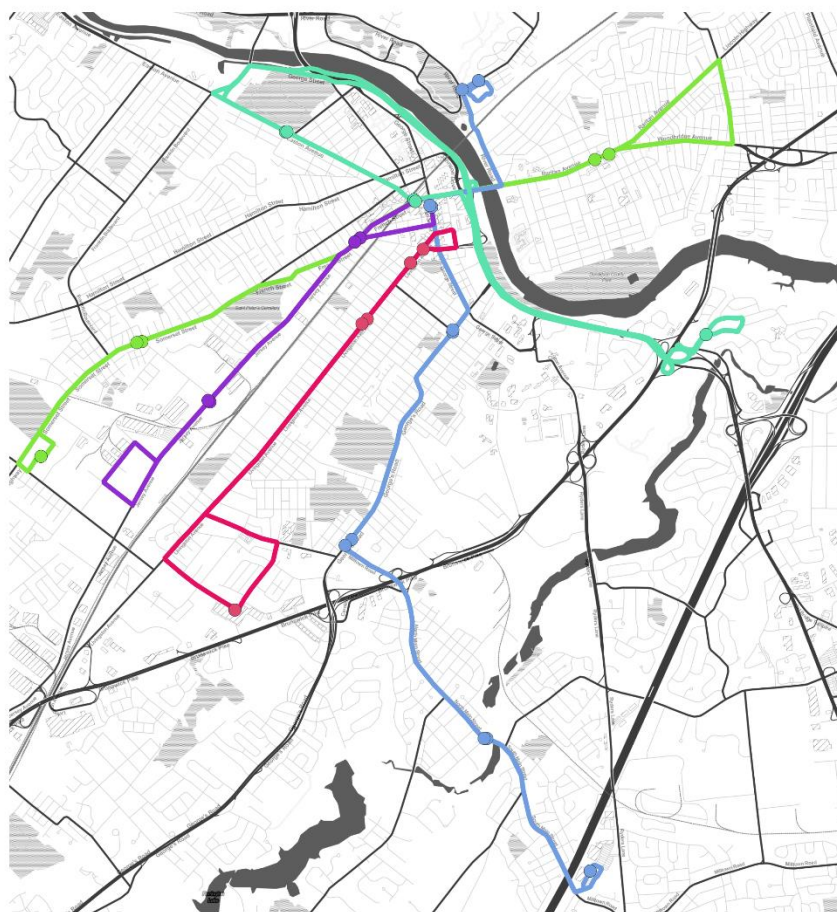
The proposed system involves five routes, all of which run through downtown New Brunswick to form a highly radial structure. The radial structure facilitates transfers both between the BACON routes themselves and with other transit service, including the Rutgers-New Brunswick bus system, New Jersey Transit buses, and Northeast Corridor train service. In several cases, the transfers are not direct, so that passengers will have to walk one or more blocks to take another BACON line or other transit service. This tradeoff was judged to be worth the time that will be saved by minimizing running on New Brunswick's most congested streets—the passenger time saved by providing direct transfers could easily be offset by the difficulty of taking turns and entering and exiting the flow of traffic downtown.

Table 1 provides more detail on the route alignments and the logic behind them, and Figures 1 and 2 depict the system with and without labeled destinations.

Table 1—Route alignment:

| Route | Alignment description and justification |
|--|--|
| College Ave. Campus to Rutgers Village | Between the apartments at Rutgers Village (between Route 1, Route 18, and the NJ Turnpike) and Rutgers' College Avenue campus. Serving St. Peter's Hospital on Easton Ave. Involves a long segment of highway, but this was judged the best way to serve both the College Ave. Campus and Rutgers Village, given that both are immediately next to Route 18. |
| Jersey Avenue | Between New Brunswick train station and Jules Lane at Jersey Ave. Providing shift change service to businesses along Jersey Ave. The out-and-back route with loops at either end should make it easier to provide more frequent service at shift changes, while potentially |

| | |
|---------------------------|---|
| | leaving vehicles available for use on other nearby routes during less frequent service. |
| Livingston Avenue | Between downtown New Brunswick and the Route 1 Walmart. Another out-and-back route serving both a major shopping center and relatively dense residential areas. |
| Milltown to Cedar Lane | Between Ryders Crossing, through Milltown's main street district and downtown New Brunswick, to the Cedar Lane apartments in Highland Park. Serves multiple commercial areas and neighborhoods. Facilitates transfer to Rutgers buses near Public Safety Building and downtown. |
| Somerset St / Raritan Ave | Between Highland Park and the Middlesex County Social Services office at How Lane and Route 27. Serving hospitals at French Street, downtown New Brunswick connections, and various supermarkets and businesses at either end of the route. |



Greater New Brunswick Bus that Actually Comes on Time - Route Map and Costs

Routes

- College Ave Campus to Rutgers Village
- Milltown to Cedar Lane
- Livingston Avenue
- Somerset St / Raritan Ave
- Jersey Avenue

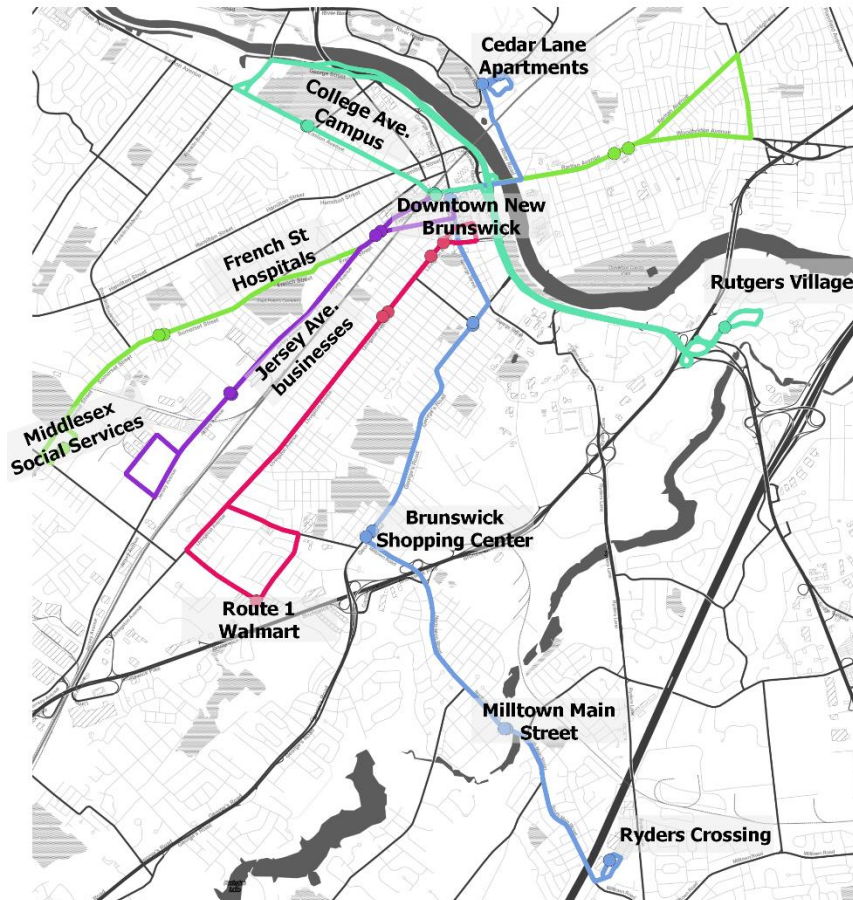
Stops

- College Ave Campus to Rutgers Village
- Jersey Avenue
- Livingston Avenue
- Milltown to Cedar Lane
- Somerset St / Raritan Ave

0 0.5 1 mi



Figure 1: System Map with Timepoints



Greater New Brunswick Bus that Actually Comes on Time - Route Map and Costs

- Routes**
- College Ave Campus to Rutgers Village
 - Milltown to Cedar Lane
 - Livingston Avenue
 - Somerset St / Raritan Ave
 - Jersey Avenue
- Stops**
- College Ave Campus to Rutgers Village
 - Jersey Avenue
 - Livingston Avenue
 - Milltown to Cedar Lane
 - Somerset St / Raritan Ave

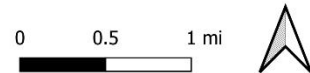


Figure 2: System Map with Labeled Major Destinations

Scheduling

Per the municipalities’ preferences, the weekday span of service for the network is from 5:30am to 11:00pm, and weekend service runs on Saturdays between 8:00am and 8:00pm. The municipalities’ guidance also limits peak hour headways to no more than 30 minutes and off-peak headways to no more than one hour, but this proposal makes more frequent service a priority for all routes at almost all times of day. Wherever possible, the routes are scheduled for 15- and 20-minute headways, but the combination of budget limits and coverage requirements means that 30-minute and 1-hour headways do appear, particularly in the evening and early morning. Speeds were assumed to be highest at night, next highest in the off peak period, and slowest in the peak hours, with allowance for higher speeds on highway segments.

Table 2—Speeds

| Period | Speed (mph) |
|----------------------------|--------------------|
| Peak (7am-9am; 4pm-6pm) | 10 |
| Off-peak | 12 |

| | |
|----------------|----|
| <i>Night</i> | 15 |
| <i>Highway</i> | 33 |

In addition, the Livingston Avenue, Milltown to Cedar Lane, and Somerset St / Raritan Ave routes are prioritized for frequent service. Due to its significant highway portion, every additional trip scheduled on the College Ave Campus to Rutgers Village route provides less benefit than any additional trip scheduled on the other three routes. Moreover, the Jersey Avenue route is scheduled mainly to get employees to and from businesses along that street around major shift changes. Service in between shifts is quite infrequent (as much as 1 hour headways), to maximize the frequency of service on the other three routes. These three routes could be regarded as the backbone of the system, due to the many destinations they serve, the well-populated neighborhoods they run through, and the presence of other transit service. Middlesex County’s MCAT routes, for example, run on both Jersey Avenue and Livingston Avenue, and BACON’s Livingston Avenue and Milltown routes would closely parallel New Jersey Transit’s 811 and 814.^{1,2}

Weekday and Saturday timetables are provided in the accompanying Excel sheets, but the distribution of trips among routes can be reviewed in Table 3. As described above, the College Ave Campus to Rutgers Village and Jersey Avenue routes receive significantly fewer trips, while the other three routes receive significantly more.

Table 3—Weekday Trips per Route:

| Route | Daily Trips (Weekday) |
|--|----------------------------------|
| <i>College Ave Campus to Rutgers Village</i> | 76 |
| <i>Jersey Avenue</i> | 63 |
| <i>Livingston Avenue</i> | 104 |
| <i>Milltown to Cedar Lane</i> | 101 |
| <i>Night</i> | 15 |
| <i>Highway</i> | 33 |

¹ See this link for a description of the MCAT service: [http://www.middlesexcountynj.gov/Government/Departments/IM/Pages/MCAT/Middlesex%20County%20Area%20Transit%20\(MCAT\).aspx](http://www.middlesexcountynj.gov/Government/Departments/IM/Pages/MCAT/Middlesex%20County%20Area%20Transit%20(MCAT).aspx).

² See, for example, the 811 route map at this link: https://d2g63oyneaimm8.cloudfront.net/sites/default/files/bus_schedules/TO811.pdf

System Finances

Again per municipality requirements, this proposal assumes that 40% of riders will pay the full fare (however it is set), 40% will pay a discounted rate of 80% of the full fare rate, and 20% will pay a half fare rate for seniors and people with disabilities. Despite these restrictions, fares were set primarily with the goal of achieving parity with the service area's existing New Jersey Transit bus service, which requires a \$1.60 fare for a one zone trip. A lower fare might encourage more demand or be a boon for riders, and a different fare might divide more easily for riders making cash payments. Nonetheless, ease of use for riders was a priority of system design, and making the system a natural complement to preexisting transit was judged the best way of designing service as conveniently as possible.

Overall, the \$1.60 fare allows service at an appreciable frequency with a small surplus of roughly \$2500, as can be seen in Table 4 below.

Table 4—Overall budget:

| <i>Category</i> | <i>Amount</i> |
|--|-------------------|
| <i>Yearly cost</i> | \$ (4,654,587.00) |
| <i>Yearly farebox revenue</i> | \$ 1,357,070.70 |
| <i>Fare per ride</i> | \$ 1.60 |
| <i>Yearly passenger trips</i> | 848,169 |
| <i>Net yearly cost</i> | \$ (3,297,516.30) |
| <i>Local, state, and federal support</i> | \$ 3,300,000.00 |
| <i>Overall operating surplus/deficit</i> | \$ 2,483.70 |

An issue of significant interest for the municipalities is the breakdown of their \$1.5 million contribution to the system. This proposal adopts each municipality's proportion of system route mileage as the main determining factor, under the reasoning that municipalities that receive more service should pay more of the cost of providing it. (Highway mileage is excluded, because under this reasoning municipalities are paying for their portion of the route mileage along which buses can stop to pick up passengers.) Under this method, New Brunswick has by far the most route miles, at roughly $\frac{3}{4}$ of the system total. Taken on its own, this would put the city's contribution at more than \$1.1 million.

However, simply multiplying the total contribution by a municipality's share of route mileage would ignore several important issues. In particular, the relative wealth of each municipality means that this formula would lead a much poorer city to subsidize a public service for several wealthier municipalities. The poverty rates of North Brunswick, Milltown, and Highland Park are statistically indistinguishable per the 2018 5-year American Community Survey, with an average rate of slightly more than 8%. New Brunswick's rate, on the other hand, is estimated to be several times higher at 34%.

For this reason, this proposal adopts a very rough adjustment by deducting from New Brunswick’s proportion of route mileage the percentage point difference between New Brunswick’s poverty rate and the mean of the other municipalities’ poverty rates, or roughly 25 percentage points. The difference (the portion of the local contribution that would go uncovered after deducting from New Brunswick’s portion) is divided equally among the three municipalities. The evenly divided difference is then added to each municipality’s portion of route mileage, producing a breakdown in which New Brunswick provides 49% of the local contribution to the system’s operating costs, North Brunswick 19%, Milltown 13%, and Highland Park 19%. Each proportion is then multiplied by the total amount of \$1,500,000 to produce the amount each municipality contributes. The result is summarized in Table 5, below.

Table 5—Breakdown of municipal contributions:

| <i>Municipality</i> | <i>Portion of route miles (excl highways)</i> | <i>% households in poverty</i> | <i>Final proportion</i> | <i>Amount contributed</i> |
|---------------------------------|---|--------------------------------|-------------------------|---------------------------|
| <i>North Brunswick Township</i> | 10.63% | 8.0% | 0.19 | \$ 289,187.11 |
| <i>Milltown Borough</i> | 4.54% | 6.3% | 0.13 | \$ 197,826.35 |
| <i>New Brunswick City</i> | 74.89% | 34.2% | 0.49 | \$ 734,321.66 |
| <i>Highland Park Borough</i> | 9.93% | 10.5% | 0.19 | \$ 278,664.88 |
| <i>Total</i> | 100% | - | 1.00 | \$ 1,500,000.00 |

Conclusion

The system described here tries to balance frequency and coverage in providing bus service to the greater New Brunswick area. The result is three “backbone” lines with headways of 15-20 minutes except early in the morning and late in the evening, along with two lines for which all-day frequency is sacrificed in order to meet specific coverage needs. The system is designed in hopes that close transfers in downtown New Brunswick can provide the benefits of frequency to users of the less frequent lines, and the benefits of geographic coverage to users of the more frequent lines. This approach involves some tradeoffs, as Table 6 makes clear by breaking down the operating costs by route. The Livingston Avenue route, to take one example, costs more than \$1,000 less to operate per day than the College Ave Campus to Rutgers Village route, while delivering more frequent service to likely higher ridership. It is worth considering what balance these four municipalities want to strike in weighing frequent service against geographic coverage.

Table 6—Cost breakdown by route:

| Route | Net daily cost | Net yearly cost | Daily Trips (Weekday) |
|--|-----------------------|------------------------|----------------------------------|
| <i>College Ave Campus to Rutgers Village</i> | \$ 4,040.26 | \$ 627,642.81 | 76 |
| <i>Jersey Avenue</i> | \$ 1,902.17 | \$ 288,057.05 | 63 |
| <i>Livingston Avenue</i> | \$ 2,767.18 | \$ 505,402.14 | 104 |
| <i>Milltown to Cedar Lane</i> | \$ 6,132.65 | \$ 1,034,018.24 | 101 |
| <i>Somerset St / Raritan Ave</i> | \$ 4,980.72 | \$ 842,396.06 | 102 |
| <i>Overall</i> | \$ 19,822.98 | \$ 3,297,516.30 | 446 |