Assignment 2—Blocking

Public Transit Fall 2020

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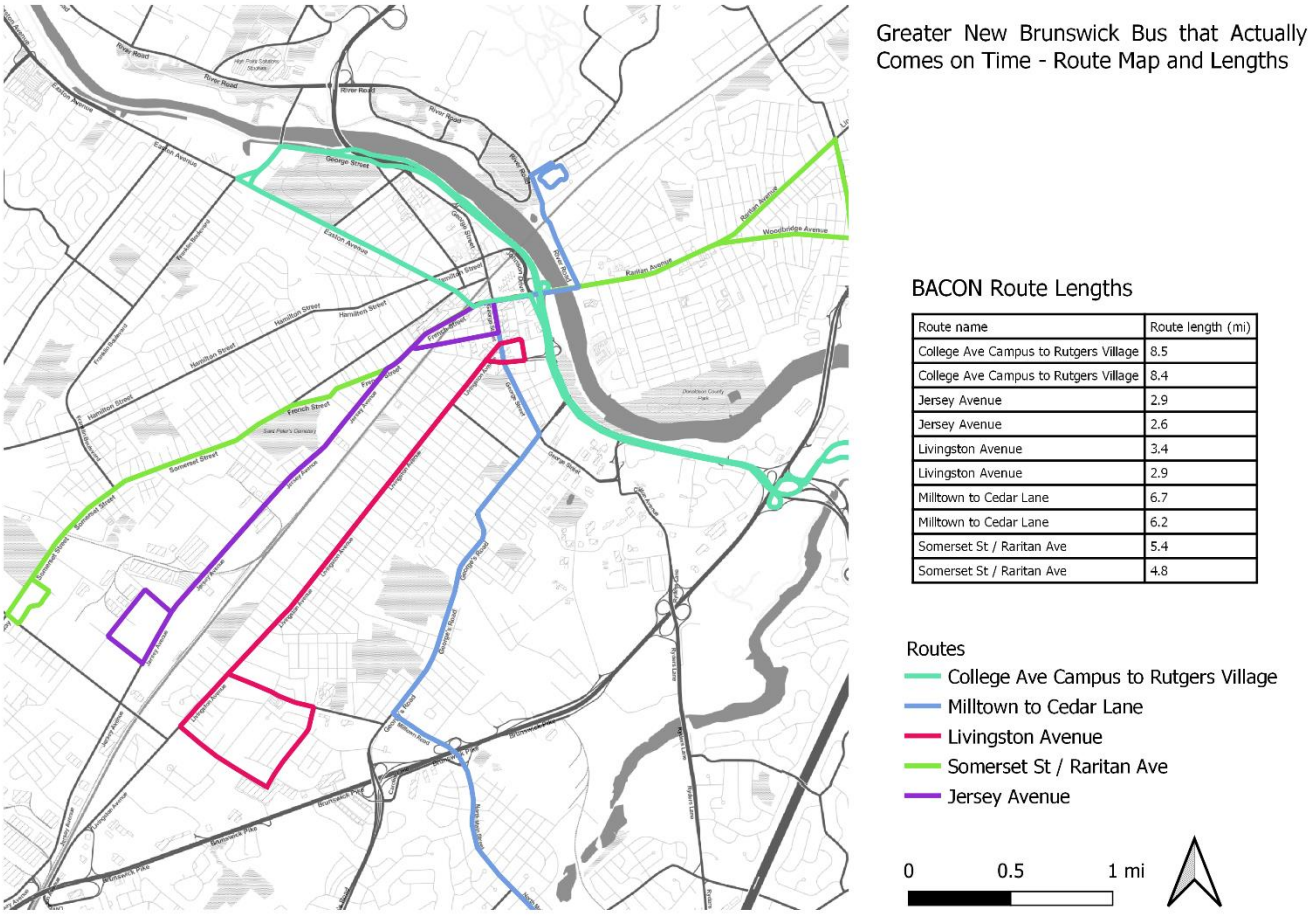
The Bus that Actually Comes on Time (BACON) of Greater New Brunswick

Introduction

Potential schedules have been proposed for the Bus that Actually Comes on Time (BACON) of Greater New Brunswick. The system consists of five lines, three of which (the Milltown to Cedar Lane, Livingston Avenue, and Somerset St / Raritan Ave routes) are scheduled to prioritize anticipated ridership. The other two (the College Avenue Campus and Jersey Avenue routes) are scheduled to provide adequate service to several important destinations. These routes and their lengths are depicted in Figure 1.

Figure 1: Route map centered on New Brunswick

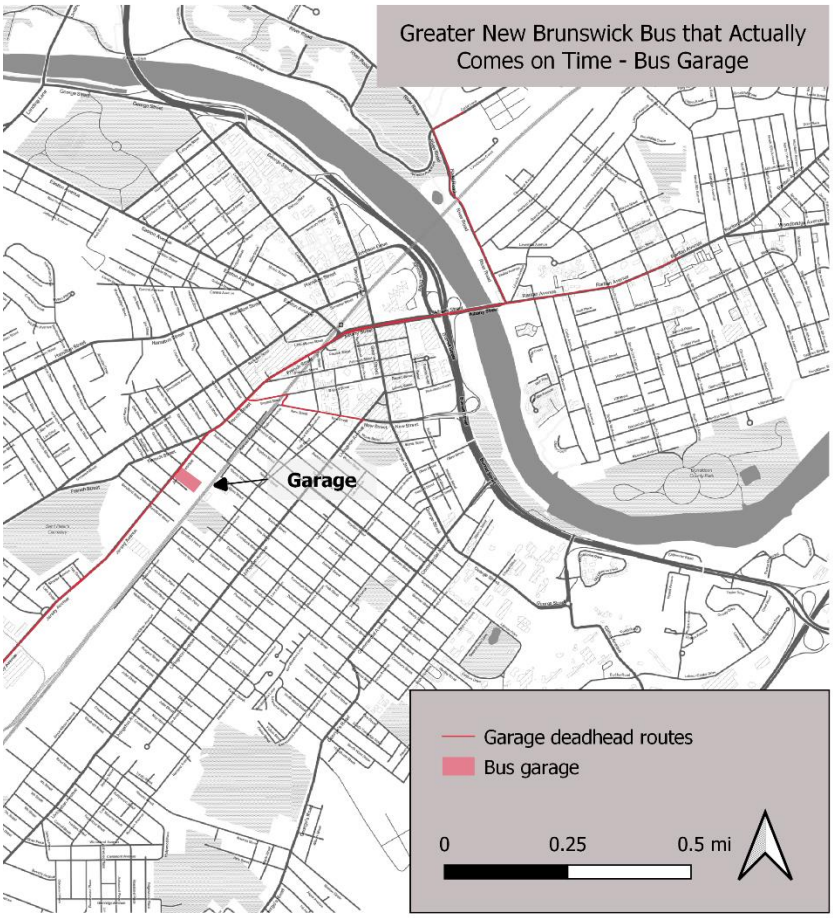


The next step is blocking, or assigning scheduled trips to individual vehicles. Proposed blocking for BACON is described below and in more detail in the provided Excel sheet.

Garage siting and recovery time

A key constraining factor in blocking is the location of the bus garage, which determines the amount of time vehicles will have to spend deadheading to and from the locations where they start and end revenue service. As part of its local contribution to the financing of the BACON system, the municipality of New Brunswick has offered to help secure a sizeable lot on Jersey Avenue for a new bus garage. The lot, depicted below in Figure 2 at the northeast corner of Jersey Avenue and Comstock Street, has an area of slightly more than two acres, and it is located in an area where industrial and commercial uses are already common. More importantly for blocking, the lot is relatively central to most of the proposed routes, which will have easy access to the garage once constructed. The capacity of the garage was assumed not to be a constraining factor, though in reality it will be.

Figure 2: Garage location



One additional constraining factor is the amount of recovery time provided to drivers per trip. Recovery time standards vary between agencies, depending usually on the contract between an agency and the operators union. With respect to driver shifts, health experts have recommended 20 minutes of break time for each 2 hours driving.[1] For purposes of blocking, this assignment used the recovery time requirements from Minneapolis-St. Paul's Metro Transit as a basis for a

[1] https://unhealthywork.org/la-bus-driver-study/a-day-in-the-life-of-a-bus-driver/.

reasonable recovery time for each blocked trip. Metro Transit's agreement with its operators union requires recovery times of at least 15% of revenue time for a lines, and no less than 7 minutes. Trips shorter than 25 minutes are exempted from the 7-minute minimum, but not the 15% requirement. This allowance was also adopted for the BACON system, which includes several lines with runtimes shorter than 25 minutes.

Table 1: Running times by line and direction

Row Labels	Peak running time (min)	Off peak running time (min)	Night running time (min)
Milltown to Cedar Lane			
Cedar Lane	39	34	27
Milltown	37	29	24
Somerset St / Raritan Ave			
Highland Park	37	31	26
How Lane	24	20	17
College Ave Campus to Rutgers Village			
Clockwise	32	27	23
Counterclockwise	29	25	22
Livingston Avenue			
New Brunswick	21	18	14
North Brunswick Walmart	17	13	11
Jersey Avenue			
Jersey Avenue	23	19	16
New Brunswick	10	8	7

Table 1 displays the runtimes for BACON routes, many of which are quite short. For example, trip durations on the Livingston Avenue and Jersey Avenue lines are as short as 13 minutes, and no longer than 25 minutes. For routes with combinations of these short trips, the 15% standard with no definite minimum both allows more flexible blocking and allows driver breaks to be scheduled where they are most convenient (e.g. at a shopping plaza rather than downtown New Brunswick).

Blocking

With schedules, a garage, and a recovery time, BACON's trips can be blocked. In general, the more frequent lines require more blocks—it takes more buses to provide more service. This is reflected in Table 2, which shows the Somerset St / Raritan Ave and the Milltown to Cedar Lane lines with the most blocks, at six each. This blocking is needed to achieve those lines' goal headways of 15-20 minutes.

Table 2: Weekday mileage and hours by block

Block	*Daily mileage*	*Daily hours*
Livingston Avenue		
L1	87.78	12:59:00
L2	87.78	12:33:00
L3	81.51	11:47:00
L4	68.97	9:24:00
Somerset St / Raritan Ave		
SR1	82	12:00:00
SR2	92.25	12:11:00
SR3	112.75	16:25:00
SR4	107.91	14:10:00
SR5	20.5	2:58:00
SR6	112.75	15:17:00
Milltown to Cedar Lane		
M1	64.25	8:12:00
M2	167.05	18:03:00
M3	141.35	15:39:00
M4	64.25	8:00:00
M5	128.5	14:09:00
M6	89.95	10:45:00
College Ave Campus to Rutgers Village		
C1	219.18	13:02:00
C2	219.18	12:52:00
C3	202.32	11:52:00
Jersey Avenue		
J1	22.12	3:16:00
J2	16.59	2:16:00
J3	44.24	6:58:00
J4	88.48	16:18:00

Less frequent lines, such as the Jersey Avenue and College Avenue lines, require fewer blocks. The College Avenue route requires only three, the fewest of all. This is due as much to routing along Route 18 as it is to relatively infrequent scheduling. With its circular route around Rutgers' College Avenue campus and back to Rutgers Village, the line can be efficiently blocked with only three vehicles running the circle in different directions.

Other routes' blocking is less efficient. Providing peak headways of 15 to 20 minutes on the Somerset St / Raritan Ave and the Milltown to Cedar Lane lines results in those lines having one or two vehicles unassigned during the off peak hours. These vehicles could be used to provide more service, but this would make operating costs higher than they would be if the buses were sent to the garage and the blocks scheduled as split shifts. Although runcutting has not be started, managing the split shifts resulting from the peak/off-peak service difference will likely be the major challenge. Scheduled as it is now, BACON's frequent peak service means the system has unused vehicles during most off peak periods. Without additional operations

funding or significant schedule changes, however, it is hard to make use of the extra buses, since no lines are scheduled frequently enough during the off peak that they would benefit from interlining.

Overall, the blocking produces the summary breakdown shown in Table 3. The system requires 23 vehicles to run its currently scheduled service, with 7 additional vehicles to satisfy the desired 20% spare factor. As mentioned, many more spare vehicles will be available for long stretches of the off peak periods, which may mean a lower spare factor could be adopted in the end to stretch BACON's funding. Also apparent in the table is another effect of the frequent service on some of the lines: higher daily mileage and much higher daily vehicle hours. BACON is scheduled under the assumption that higher frequencies will be rewarded with more riders, but the blocking makes clear what those frequencies cost in terms of wear and tear on the buses.

Table 3: Weekday blocking summary by line

Line	*Vehicles Needed (+20% Spare)*	*Total Daily Mileage*	*Total Daily Vehicle Hours*
Livingston Avenue	4 (+1)	326.04	46:43
Somerset St / Raritan Ave	6 (+2)	528.16	73:01
Milltown to Cedar Lane	6 (+2)	655.35	74:48
College Ave Campus to Rutgers Village	3 (+4)	640.68	37:46
Jersey Avenue	4 (+1)	171.43	28:48
Total	23 (+7)	2321.66	261:06