Transit Route Location

E. Beimborn, University of Wisconsin-Milwaukee

Elements of Successful Transit

- Concentrated trip ends: Activities that relate to transit should be located close to transit stops.
- Quality access system: Provide safe, direct and easy access to transit by pedestrians, bicyclists and automobile users. Minimize distances from vehicle door to buildings.
- Transit oriented street patterns: Permit through routing, direct service, few turns. Control through automobile traffic if necessary.
- Market orientation – User oriented transit

User Oriented Transit

- Services are designed to maximize customer satisfaction and needs
  - Direct trip origin to destination
  - No transfers
  - Schedules match needs
  - Reasonable cost
  - Similar users
  - Good access on both ends of the trip
  - Clean, comfortable vehicles
  - Good user information

3

Route Location

- Where should it be?
  - Concentrate on service to users, maximize demand
- How long should it be?
  - Determines vehicle fleet size, scheduling, costs

4

Route Location Guidelines

- Begin and end at major trip generators
- Serve as many major trip generators as possible
- Direct, two-way service, avoid loops or backtracking

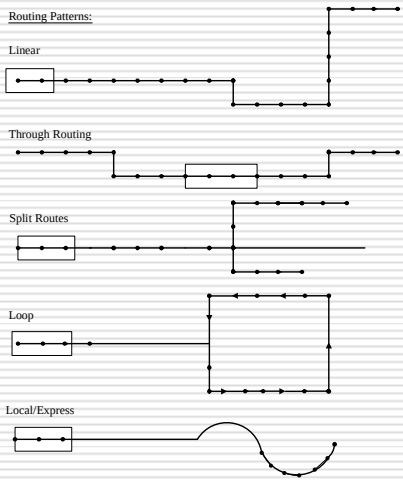
5

Route Location Guidelines

- Avoid overlapping of routes, maintain good route spacing;
  ½ mile if there is good pedestrian access
- Consider traffic operations, geometry, turn around, layover point locations
- Consider rider access, walk, park, drop-off

6

Routing Patterns

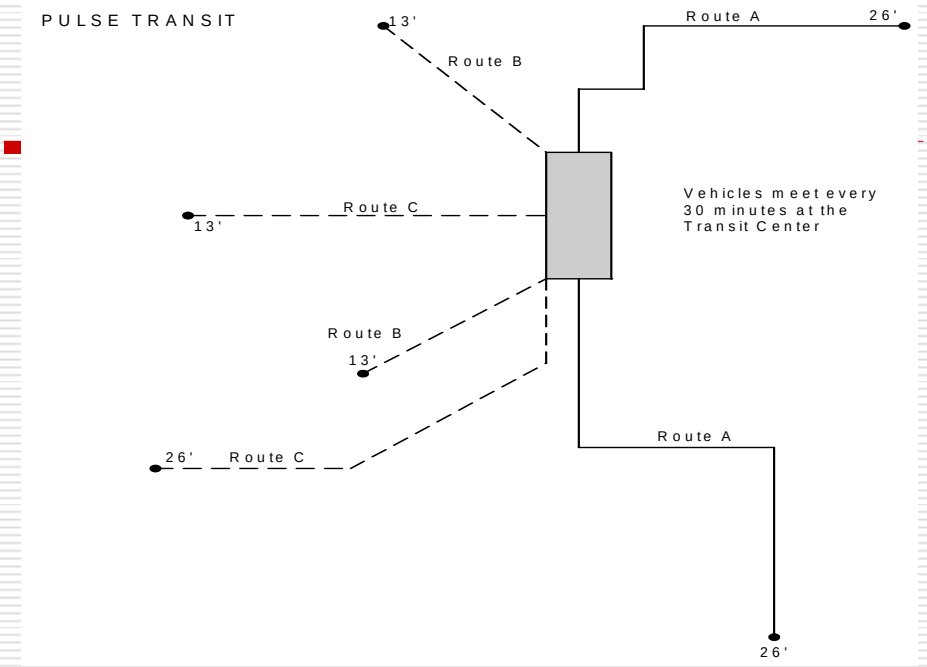


7

Pulse Transit

- Similar to airline hub and spoke system.
- Vehicles meet at fixed time intervals (i.e. every 30 minutes) at a central location (transit center)
- Transit route length should be just less than ½ of the interval, i.e. 13 or 26 or 39 minutes for a 30 minute pulse interval, this uses 1, 2 or 3 vehicles
- Routes can be through routes, but layover is at transit center

8



9

How many vehicles?

- Route A: 4 vehicles, 2 for northeast side, 2 for south side
- Route B: 2 vehicles, 1 for northwest, 2 for southwest
- Route B: 3 vehicles, 1 for west, 2 for southwest
- 9 vehicles needed.

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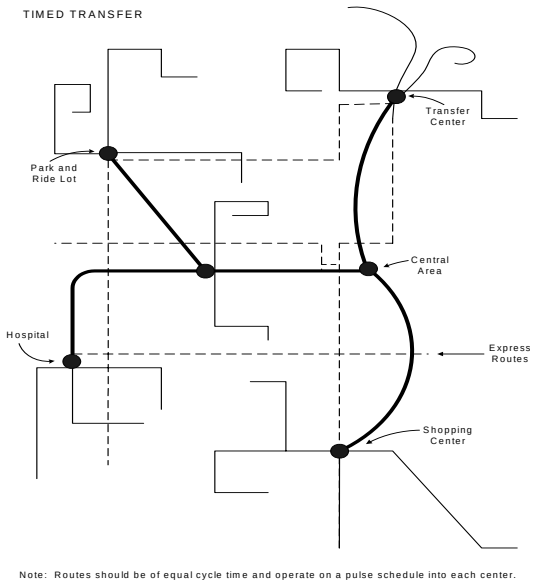
Pulse Transit in Larger city



Note: Routes should be of equal cycle time and operate on a pulse schedule into each center.

11

New Services

- New services should be labeled as experimental to the transit board and specific target goals should be set in order to continue the service on a permanent basis.
- New services should be aggressively marketed to potential users. Develop route level market information from the point of view of the user (a good idea for existing routes as well).

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New Services

- When starting the new service, provide back-up capacity for the first week to handle higher than expected demand if it occurs. Adjust vehicle supply to demand over time.
- Generally new routes take some time to build ridership as shown below. Marketing can make this occur faster.

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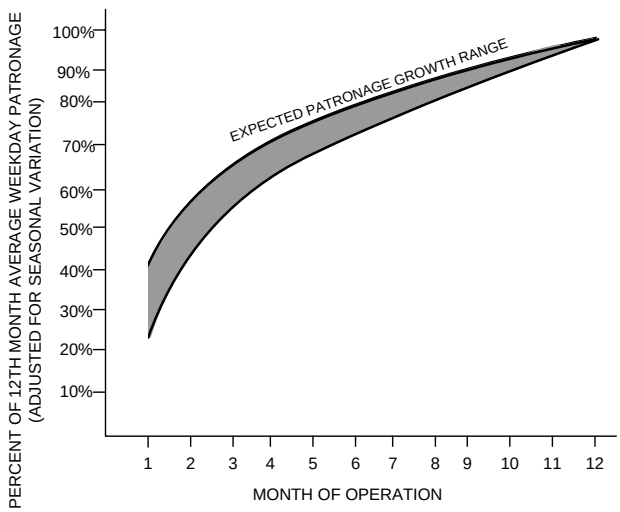
GENERAL RIDERSHIP GROWTH CURVE
FOR NEW BUS SERVICES



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Deletion of a Route

- Far more difficult than adding service
- Need for well defined and accepted deletion standards. Based on goals, objectives, performance indicators
- Need for real planning skills
  - No longer engineering but social policy
  - Work with community groups/affected citizens

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Deletion of a Route (continued)

- Need for innovation
  - Consider substitute service, taxicabs, etc.
- Need for flexibility

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Information Sources

- Census
  - Low income
  - Auto availability
  - Age
  - Journey to work
- Planning Agency
  - Land use
  - Major trip generators

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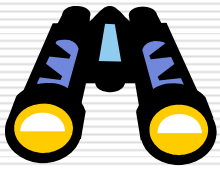
Information Sources

- Traffic Department
  - Traffic data
  - Street Geometry
  - Parking regulations
- Field Check
  - Character of housing
  - Neighborhood character
  - Trip generators
- Community, Political comments



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In-House Data

- Running times, speeds
- Schedule adherence
- Passenger, driver comments
- On-board surveys
- On-off counts
- Transfer counts

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Route Diagnosis

- After developing a route network, it should never be considered “good for all time.”
- Transit rider requirements are apt to change over time, perhaps rapidly. Usage should be monitored and evaluated at regular intervals, perhaps once to twice each year, or more often in rapidly changing areas.

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Route Diagnosis

- The following pages provide forms than can be used to evaluate current routes
  (from *Transit System Performance Evaluation and Service Change Manual,* prepared for the State of Pennsylvania and reprinted by US DOT, February 1981)

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TABLE IV-2
ROUTE OPERATING DATA

Route No.: _____
Name: _____
Date: _____

Round Trip Route Length (Miles)

- Local -
- Short Run -
- Express -

Weekday Service Utilization

Trips	Passengers
Total	

Maximum Load Points

Direction	Location
A.M. Peak	
Inbound -	
Outbound -	
Midday	
Inbound -	
Outbound -	
P.M. Peak	
Inbound -	
Outbound -	

Fare Structure

- Bus Fare -
- Additional Zones -
- Maximum One-Way Fare -
- Transfers -

Vehicle Requirements

- A.M. Peak -
- Midday Base -
- P.M. Peak -
- Evening -
- Saturday -
- Sunday -

Summary of Service

Time Period	Scheduled Headway	Total Trips	Normal Cycle Time
A.M. Peak (6-9 a.m.)			
Midday (9-4 p.m.)			
P.M. Peak (4-6 p.m.)			
Evening (6-10 p.m.)			
Saturday			
Sunday			

Miles/Hours of Service

	Weekday	Saturday	Sunday
Scheduled Miles			
Pay Hours			
Miles/Hour			

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TABLE IV-3
CHECKLIST FOR POTENTIAL ROUTE IMPROVEMENTS

Route: _____ Prepared by: _____

Date: _____

	Yes	No	If "YES," describe:
1. Alignment			
a. Could the route be extended to serve major residential/activity concentrations?	____	____	
b. Could the route be curtailed without losing significant patronage?	____	____	
c. Could segments of the route be realigned to provide better service/increase speed?	____	____	
d. Does the route duplicate other routes in serving major markets?	____	____	
2. Headways/Turnbacks			
a. Are "load standard" headways excessive or insufficient?	____	____	
b. Are "policy" headways at variance with service standards?	____	____	
c. Could certain trips be "turned back" midroute without violating headway standards?	____	____	
d. Is there insufficient patronage early morning, late evening, or weekends to justify service?	____	____	
e. Could schedules be better coordinated with predominate shift or school times?	____	____	

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TABLE IV-3 (continued)
CHECKLIST FOR POTENTIAL ROUTE IMPROVEMENTS

	Yes	No	If "YES," describe:
3. Schedule Adherence/Running Time			
a. During short headway periods, do vehicles "bunch up?"	____	____	
b. Are there significant deviations between actual and scheduled running times by route segment by time period?	____	____	
c. Is there insufficient or excessive recovery time at each end of the route?	____	____	
4. Schedule Coordination			
a. Should route be jointly scheduled with another route where service duplication exists?	____	____	
b. Where there is major transfer activity, should schedules be coordinated during policy headway periods?	____	____	
c. Could route be "hooked" with another route where there is a major transfer activity?	____	____	
5. Traffic Aids			
a. Are recovery/turnaround points inadequate for vehicle storage?	____	____	
b. Are there serious congestion points along the route?	____	____	
c. Does illegal parking/truck loading seriously impede vehicle movement?	____	____	

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TABLE IV-3

CHECKLIST FOR POTENTIAL ROUTE IMPROVEMENTS

Route: _____ Prepared by: _____

Date: _____

	Yes	No	If "YES," describe:
1. Alignment			
a. Could the route be extended to serve major residential/activity concentrations?	____	____	
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c. Could certain trips be "turned back" midroute without violating headway standards?	____	____	
d. Is there insufficient patronage early morning, late evening, or weekends to justify service?	____	____	
e. Could schedules be better coordinated with predominate shift or school times?	____	____	

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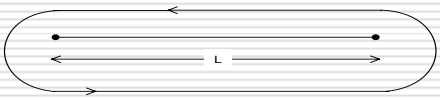
Basic Service Relationships



Cycle time = round trip travel time + layover time

$$= \frac{2 * \text{Length}}{\text{Speed}} + \text{Layover}$$

$$= \frac{2 * L * 60}{S} + TA + TB$$

$$= \frac{120L}{S} + TA + TB$$

Varies by time of day and location.

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Vehicles Required

Number of Vehicles is cycle time divided by headway

NV = Cycle time/Headway

Example: a route with a 100 minute cycle time and a 25 min headway needs 4 vehicles, at a 30 minute headway,

NV = 3.33, You must still provide 4 vehicles (round up to a whole number)

Costs directly relate to number of vehicles operated

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Headway

- Policy Headway: Set by transit board, i.e. a vehicle every 30 minutes, regardless of demand.
- Demand based headway: Provide capacity accommodate peak point demand in passengers per hour
  - Peak location on route
  - Peak direction
  - Peak time of day
- Headway = Vehicle capacity/Demand

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Headway

- Vehicle capacity is the number of seats times a load factor
- Headway = 60*Seats*LF/Demand
- Example, a route has a peak demand of 200 persons per hour, uses 40 passenger buses and allows a load factor of 1.25
  - Headway = 60*40*1.25/200
  - Headway = 60 * ¼ = 15 minutes

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Combined equation:

- Combining all factors, the required number of vehicles is:

$$NV = \frac{2 * L * D}{(S * C * LF)} + \frac{D * (TA + TB)}{C * LF * 60}$$

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Combined Equation

- Costs decrease inversely with
  - Vehicle capacity (seats/vehicle
  - load factor
- Costs increase directly with:
  - Route length
  - Demand
  - Layover time
  - Average vehicle speed

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Costs depend on daily hours and miles

Daily hours = (peak veh. * peak length + base veh. * base length) * pay/platform ratio

Daily miles = daily hours * speed_* (1 + deadhead)

* pay/platform ratio

- Pay/platform ratio, ratio of hours paid to drivers vs service hours
- Deadhead: Vehicle not in service, to and from garage

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TRANSIT ROUTE WORKSHEET

DATA	
Route length miles - (L)	10 miles
Average speed - mph - (S)	15 mph
Layover - min (TA + TB)	5 min.
COMPUTE	
Cycle time = (120 * L/S) + (TA + TB)	(120 * 10) / 15 + 5 = 85 minutes
DATA	
Peak headway - minutes - (PH)	15 min.
Base headway - minutes (BH)	30 min.
Seats per bus - (C)	50
Load factor - (LF)	1.2
COMPUTE	
Peak vehicles = cycle time/PH	85/15 = 5.67, use 6 buses
Base vehicles = cycle time/BH	85/30 = 2.83, use 3 buses
Capacity = SE * LF * 60/PH	50 * 1.2 * 60/15 = 240 passengers/hour
DATA	
Length peak - hours - (P)	4 hours
Length base - hours - (B)	12 hours
Deadhead - portion - (D)	.10
Pay/Platform ratio - (PP)	1.1
COMPUTE	
Daily vehicle hours = (Peak veh. * P + Base veh. * B) * PP	(6 * 4 + 3 * 12) * 1.1 (24 + 36) * 1.1 = 66 hours
Daily vehicle miles = vehicle hours * speed * (I+D)/PP	66 * 15 * 1.1/1.1 = 990 miles

Example as a spreadsheet

			Estimated Route Performance for Next Year	
Route	Red (1)	Brown (2)	Yellow (3)	Blue (4)
length (miles)	7.80	9.20	9.00	9.30
headways				
weekdays peak	30.00	30.00	20.00	20.00
weekdays base	30.00	30.00	30.00	30.00
sat/hol	30.00	30.00	30.00	30.00
speed (mph)	10.40	12.30	12.00	12.40
hrs peak	4.00	4.00	7.00	7.50
hrs base	8.00	8.00	5.00	4.50
hrs sat/hol	9.00	9.00	9.00	9.00
weekdays				
peak veh (calc)	3.00	2.99	4.50	4.50
peak buses	3	3	5	5
base veh (calc)	3.00	2.99	3.00	3.00
base buses	3	3	3	3

Acknowledgements

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- The opinions expressed are the product of independent university work and not necessarily those of the sponsoring agencies or of the agencies supplying data for the project.