

Corridor Analysis

Outline

- **Corridor Objectives and Strategies**
- **Express**
- **Local**
- **Limited Stop Overlay on Local Service¹**
- **Deadhead**

1 Stacey Schwarcz, "Service Design for Heavy Demand Corridors: Limited-Stop Bus Service." MST Thesis, MIT, September 2004

Corridor Design Objectives

1. To reduce cost for providing existing level of service, or
2. To improve the level of service without increasing resources

Operational Objectives:

- Increase the operating speed
- Reduce the vehicle miles of service
- Reduce unnecessary slack time at terminals
- Maintain high, uniform vehicle loadings on all segments

Issues are:

Service Quality Impacts:

- Changes in wait time, walk distance, and need to transfer

Ridership Changes:

- What ridership changes will result from level of service impacts?

Strategies

A. Express Service

- Downtown orientation
- Zonal Express
- Limited Stops on Express Segment

B. Local Service

- Short Turns/Lines
- Restricted Zonal
- Semi-Restricted Zonal
- Limited Stop Zonal

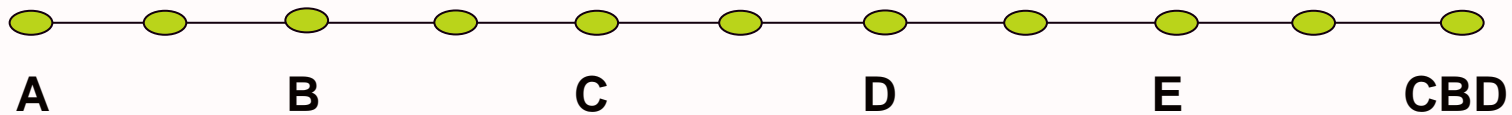
C. Light Direction Strategies

- Complete Deadheading
- Partial Deadheading

Local and Express Service Symbols and Example Schedules

1. Local Service, Route 1

SUBURBS



SCHEDULE Route 1					
A	B	C	D	E	CBD
7:00 A.M.	7:08	7:15	7:25	7:32	7:45
7:10	7:18	7:25	7:35	7:42	7:55
7:20	7:28	7:35	7:45	7:52	8:05
7:30	7:38	7:45	7:55	8:02	8:15
7:40	7:48	7:55	8:05	8:12	8:25
7:50	7:58	8:05	8:15	8:22	8:35
8:00	8:08	8:15	8:25	8:32	8:45

Local and Express Service Symbols and Example Schedules (cont'd)

1. Express Service, Route 1E

SUBURBS



SCHEDULE Route 1E					
A	B	C	D	E	CBD
7:10 A.M.	7:18	----	----	----	7:35
7:30	7:38	----	----	----	7:55
7:45	7:53	----	----	----	8:10
8:00	8:08	----	----	----	8:25
8:15	8:23	----	----	----	8:40
8:30	8:38	----	----	----	8:55

Issues In Designing Express Services

Downtown Routing: Minimize time on local streets

Adding Stops to Express Portions: Minimize impact on capacity and running time

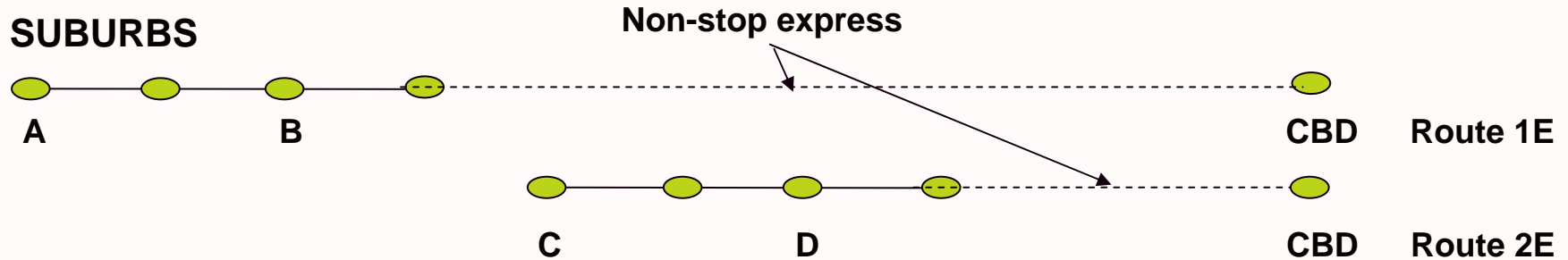
Reverse Commuting: Maximize potential for reverse commuting traffic

Fares: What fare premium is appropriate?

Local Service Interaction:

- **Is parallel local service viable?**
- **Is express time advantage sufficient to attract (almost) all downtown riders?**

Zonal Express Service



SCHEDULE - Route 1E

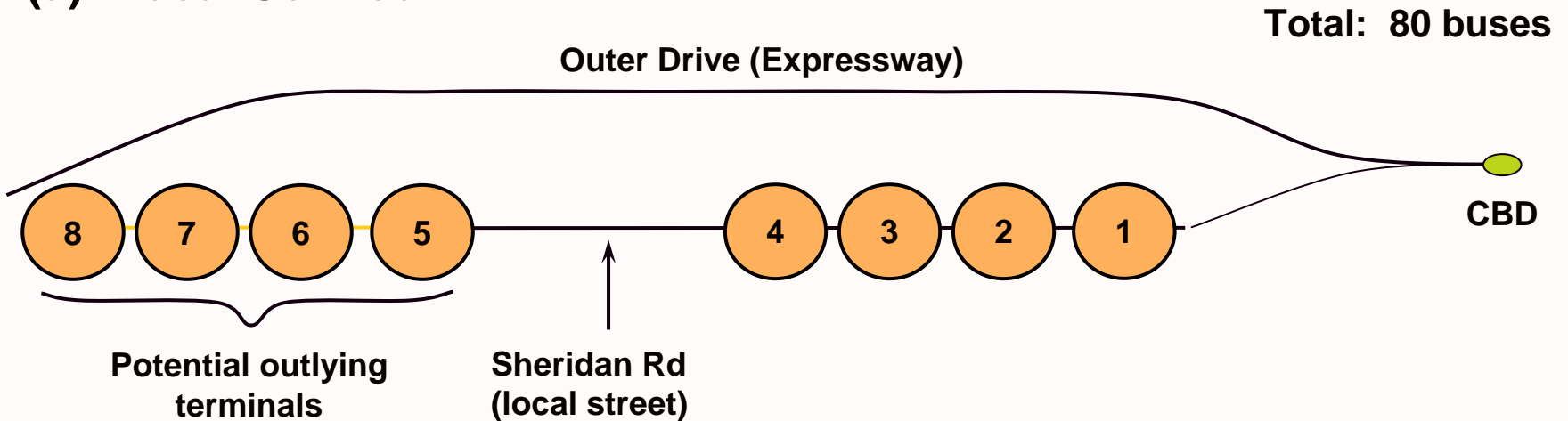
A	B	C	D	E	CBD
7:00 A.M.	7:08	----	----	----	7:32
7:20	7:28	----	----	----	7:52
7:40	7:48	----	----	----	8:12
8:00	8:08	----	----	----	8:32

SCHEDULE - Route 2E

A	B	C	D	E	CBD
----	----	7:05	7:13	----	7:45
----	----	7:20	7:28	----	7:45
----	----	7:35	7:43	----	8:00
----	----	7:50	7:58	----	8:15
----	----	8:05	8:13	----	8:30

Zonal Express Service in the Sheridan Road corridor (simplified)

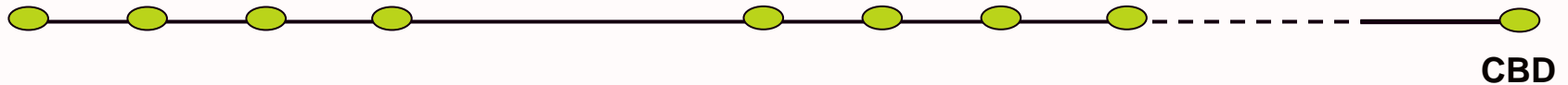
(a) Local Service



Zonal Express Service in the Sheridan Road corridor (simplified)

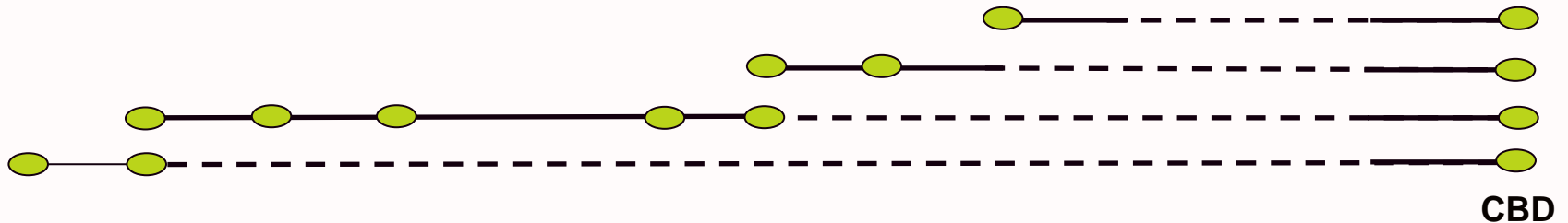
(b) Conventional Express Service

Total: 72 buses

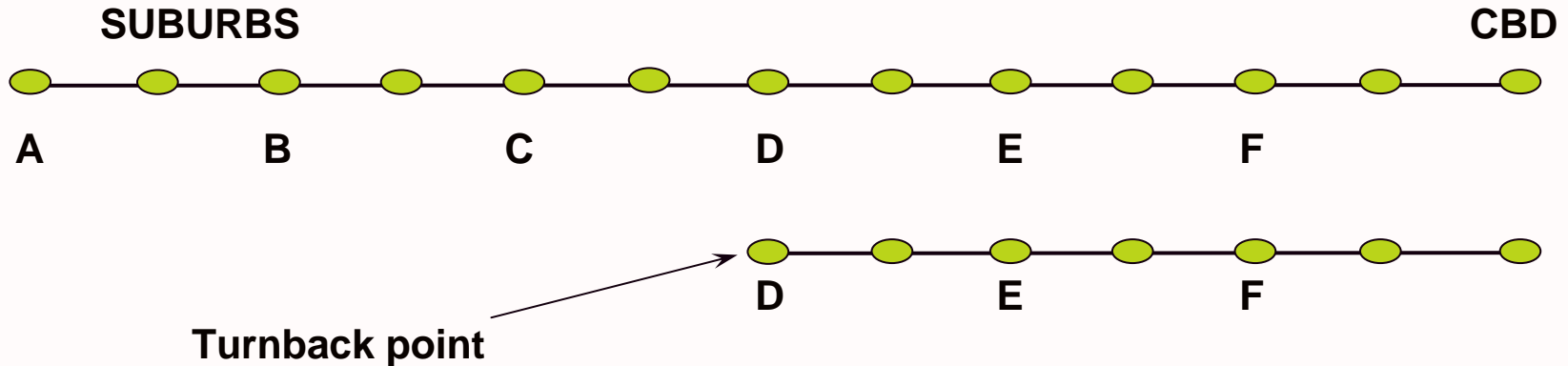


(c) Zonal Express Service

Total: 47 buses



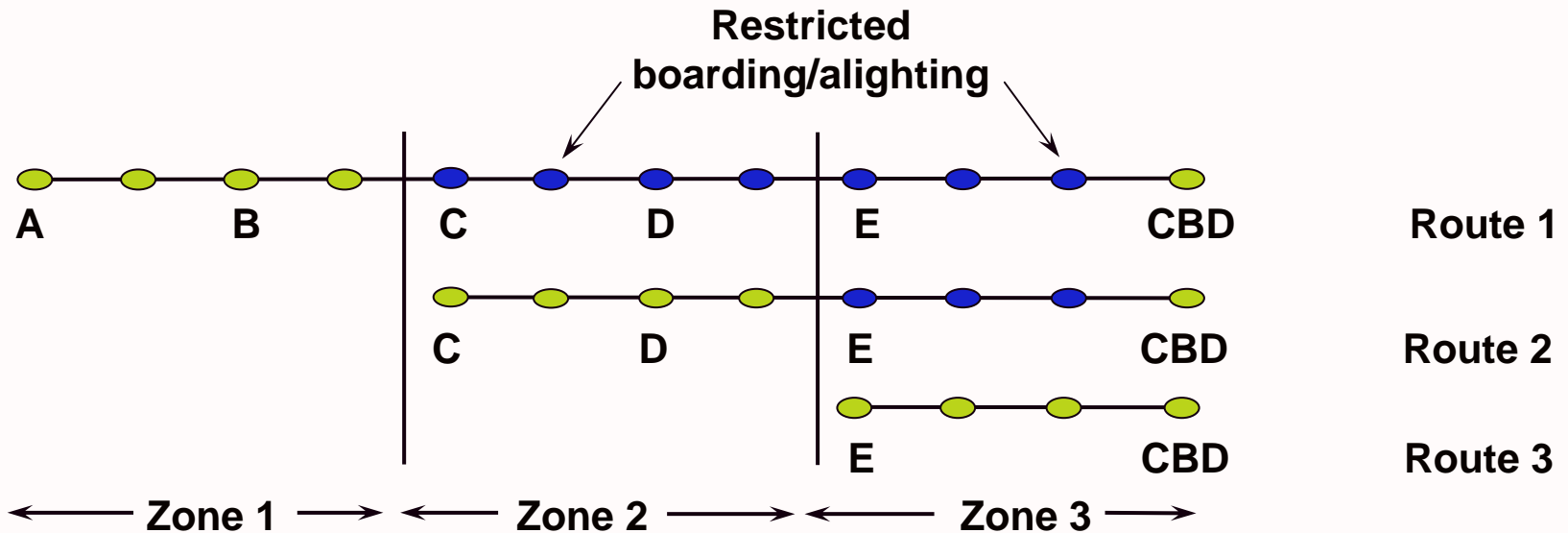
Short-Turning Local Service



SCHEDULE - Inbound

A	B	C	D	E	F	CBD
7:00 A.M.	7:08	7:15	7:18	7:25	7:32	7:45
			7:25	7:32	7:39	7:52
7:15	7:23	7:30	7:33	7:40	7:47	8:00
			7:40	7:47	7:54	8:07
7:30	7:38	7:45	7:48	7:55	8:02	8:15
			7:55	8:02	8:09	8:22

Restricted Zonal Local Service



- Inbound buses do not stop except to let passengers alight; boarding prohibited. Outbound buses do not stop except to let passengers board; alighting prohibited.

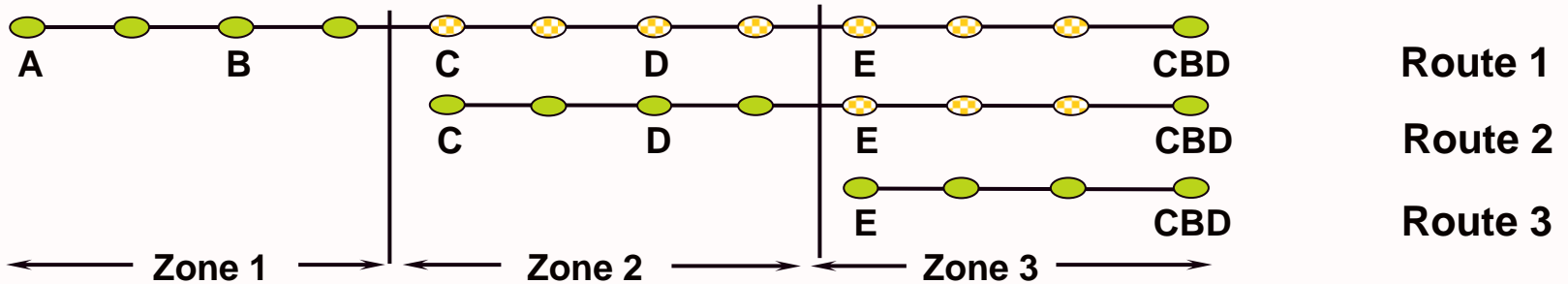
Restricted Zonal Local Service

SCHEDULE - Route 1					
A	B	C	D	E	CBD
7:00	7:08	(7:15)*	(7:24)	(7:30)	7:42
7:15	7:23	(7:30)	(7:39)	(7:45)	7:57
7:30	7:38	(7:45)	(7:54)	(8:00)	8:12

SCHEDULE - Route 2					
A	B	C	D	E	CBD
		7:10	7:20	(7:27)*	7:39
		7:22	7:32	(7:39)	7:51
		7:34	7:44	(7:51)	8:03

SCHEDULE - Route 3					
A	B	C	D	E	CBD
				7:25	7:39
				7:35	7:49
				7:45	8:59

Semi-Restricted Zonal Local Service (Inbound only)

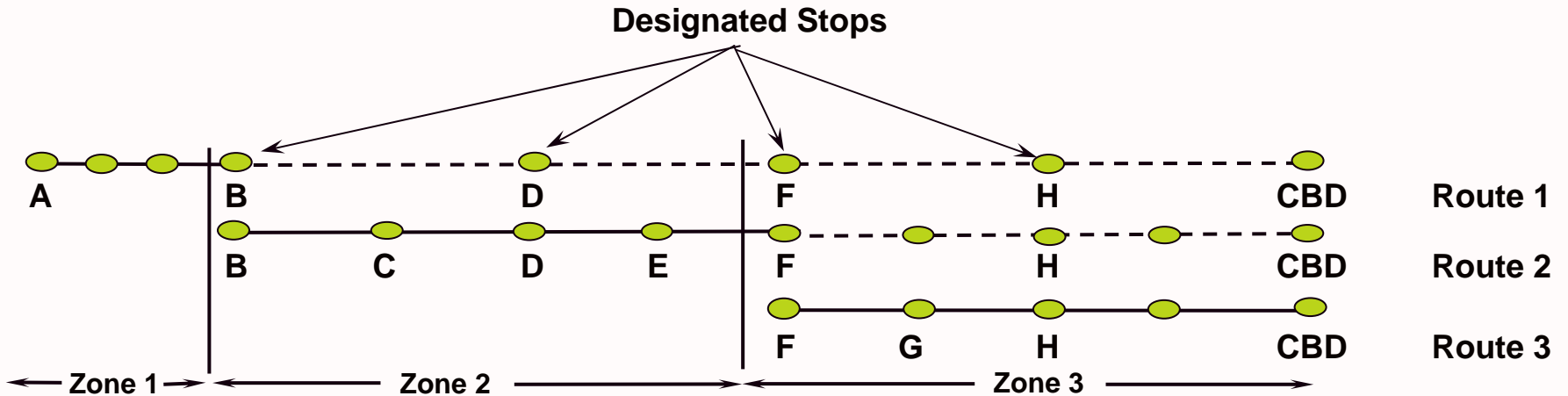


Buses stop only to allow passengers to alight; once stopped, waiting passengers may board.

SCHEDULE - Inbound						
A	B	C	D	E	CBD	
				7:25	7:39	Route 3
		7:10	7:20	(7:27)*	7:39	Route 2
7:00	7:08	(7:15)*	(7:24)	(7:30)*	7:42	Route 1
				7:35	7:49	Route 3
		7:22	7:32	(7:39)*	7:51	Route 2
7:15	7:23	(7:30)*	(7:39)*	(7:45)*	7:57	Route 1
				7:45	8:59	Route 3
		7:34	7:44	(7:51)*	8:03	Route 2
				7:55	8:09	Route 3
7:30	7:38	(7:45)	(7:54)	(8:00)*	8:12	Route 1

* () means on-board passengers may alight; waiting passengers may board only if bus stops to let someone alight.

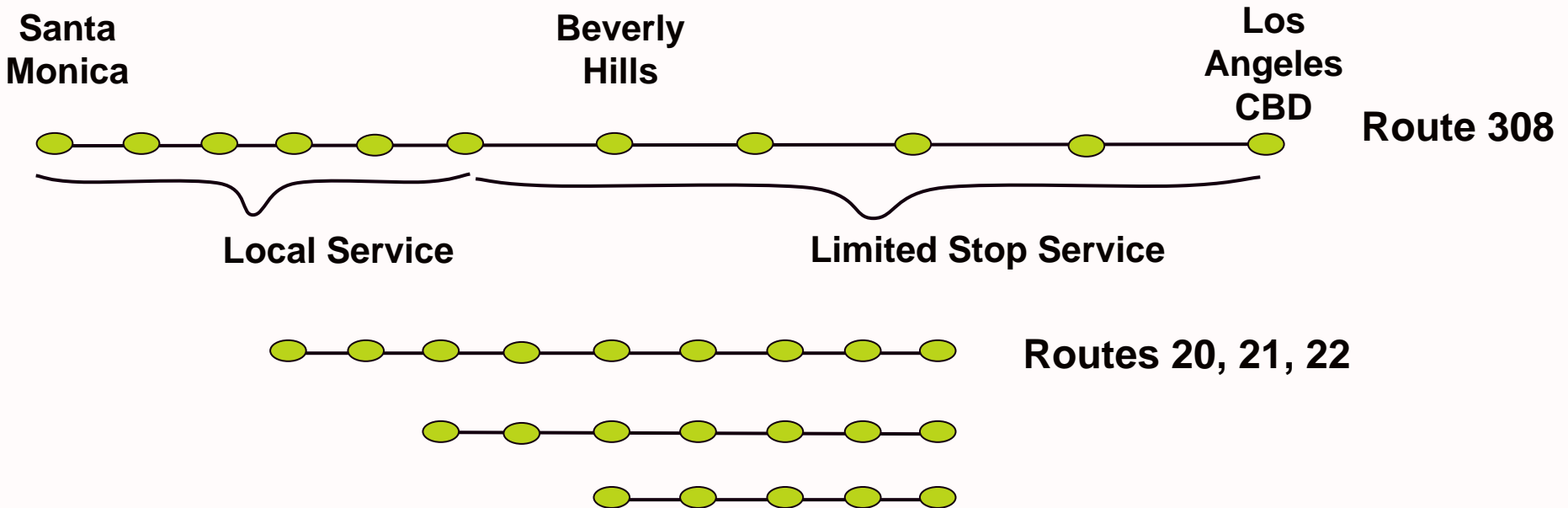
Limited-Stop Zonal Local Service



SCHEDULE - Inbound

A	B	C	D	E	F	G	H	I	CBD	
7:00 AM	7:12	-----	7:19	-----	7:26	-----	7:33	-----	7:40	Route 1
	7:13	7:17	7:22	7:27	7:31	-----	7:38	-----	7:45	Route 2
					7:30	7:35	7:40	7:45	7:50	Route 3
7:15	7:27	-----	7:34	-----	7:41	-----	7:48	-----	7:55	Route 1
	7:28	7:32	7:37	7:42	7:46	-----	7:53	-----	8:00	Route 2
					7:45	7:50	7:55	8:00	8:05	Route 3

Bus Service in Wilshire Boulevard Corridor



Limited Stop Overlay on Local Service: Research Objectives

- **Establish guidelines for the addition of limited-stop service**
- **Create a procedure and model for evaluation and design**
- **Apply the model to CTA case studies**

Ref: Stacey Schwarcz, "Service Design for Heavy Demand Corridors: Limited-Stop Bus Service." MST Thesis, MIT, September 2004

Key Elements of Limited-Stop Service Design

- **Stop Reduction**
- **Running Time Savings**
 - Dwell times
 - Traffic and traffic signal delay
- **Frequency split**
- **Resources: neutral or increased?**

CTA Limited-Stop Routes

- **3/X3,4/X4, 49/X49, 55/X55, 80/X80**
- **Average Route Length: ~8 miles; range: 7.5 to 16 miles**
- **Stop Reduction: 60-70% of existing stops**
- **Run Time reductions range from 13-26%**
- **Frequency split: 50-60% local service**

Findings

- **Success of limited-stop service depends on**
 - Running time savings
 - Frequency split between local and limited-stop service
 - Demand pattern: trip end concentration and trip length
 - Large number of limited-stop-only riders
- **Eliminating stops affects access time: the number of limited-stop only riders decreases as stop spacing increases**
- **Eliminating stops on CTA routes has had moderate impacts (13-26%) on running times**
- **Potential Strategy for Limited-Stop Service**
 - Increase stop spacing while maintaining low frequency service on the local

Model Overview

- **Model Assumptions**
 - Demand is fixed
 - Local Stop Spacing is fixed
 - Total Dwell Time for the route does not change based on the stop spacing, frequency configuration, or boardings
- **Makes use of AVL and APC data to determine running times and the O-D demand matrix**
- **Evaluates a specific user defined stop spacing and headway configuration**
- **Calculates travel time components for each O-D pair**

Model Overview (Continued)

- **Assignment:**
 - **Stop Choice**
 - **Route Choice**
 - **Local captive, choice, and limited-stop only riders**
 - **High number of limited-stop-only riders needed for success**
 - **Based on minimum weighted travel time**
 - **Access Time=3, Wait Time=2, In Vehicle Time=1**
(Loosely based on CATS)
- **Calculates evaluation measures**
 - **Evaluation measures: net passenger minutes of total travel time, number of limited-stop only riders**

Deadheading Strategies

A. Deadhead all vehicles on route:

Possible with one (or more) routes of short turn or zonal route system

B. Deadhead some vehicles on route:

Deadhead every other bus (or 2 out of every 3) with remainder in service

Issues:

1. Can a vehicle be saved by deadheading?
2. Will there be adverse public reaction?

Key Factors in Determining the Potential Benefit of Route Redesign of a Corridor

Overall Trunk Frequency

		Below 1.7 f_{min}^*	1.7 f_{min} - 2.0 f_{min}	2 f_{min} - 4 f_{min}	Above 4 f_{min}
Corridor Length	Below 2 miles	NOT A CANDIDATE FOR REDESIGN			
	2-4 miles			MILD POTENTIAL	CONSIDERABLE POTENTIAL
	4-6 miles				
	6-8 miles				
	Above 8 miles				HIGH POTENTIAL

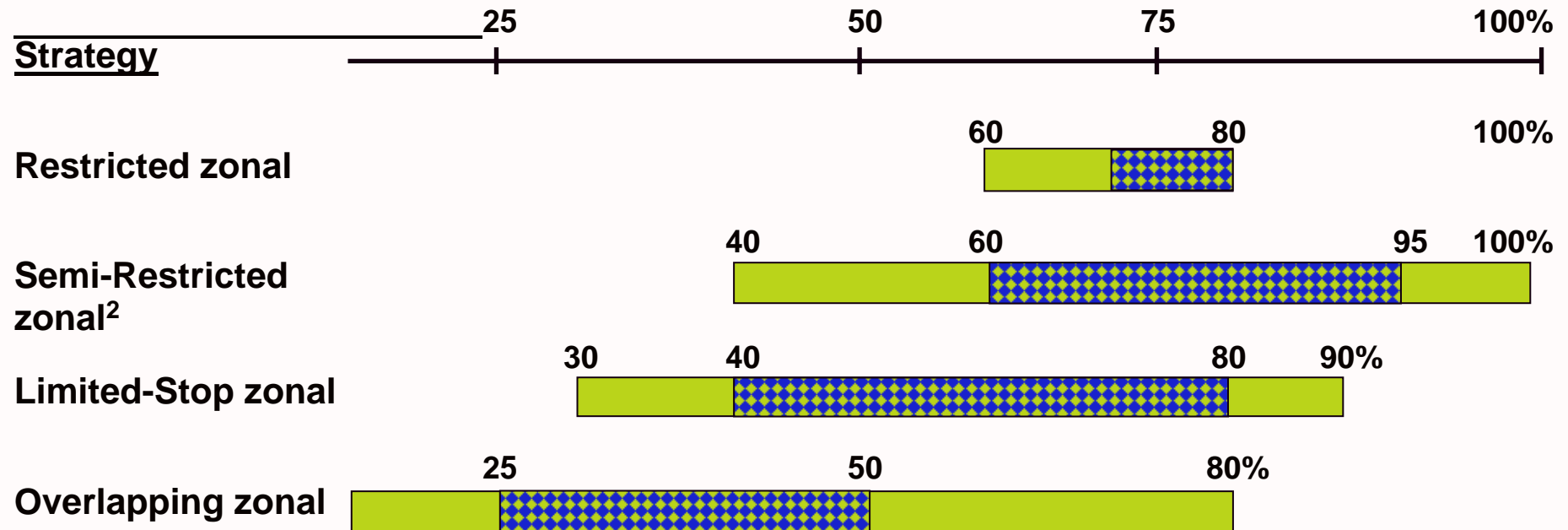
* f_{min} = minimum acceptable frequency for a peak period radial route

Advantages and Disadvantages of Local Service Operating Strategies

	Short-Turn	Restricted Zonal	Semi-Restricted Zonal	Limited-Stop Zonal
Need for schedule coordination and strict adherence	valuable in a.m. vital in p.m.	none	none	unnecessary in a.m. valuable in p.m.
Reliance on overtaking	none	strong	moderate	strong
Wait time impact*	up by 90% in outer segment, by 20% in inner segment	up by 90% throughout	up by 90% in outer segment, by 20% in inner segment	up by 90% in outer segment, by 20% in inner segment
In-vehicle time reduction	none	considerable	moderate	considerable
Walk-distance impact*	none	none	none	up by 0.2 mi. for some outer segment passengers
Difficulty in public comprehension	little	considerable	considerable	moderate
Most favorable conditions for vehicle savings:				
Corridor length	short	long	any	long
Fraction of local (non-CBD) travel	moderate to high	small	moderate	moderate to high
Outer segment volume	low	low	low	any

* Average impact to peak direction travelers in typical application

Strategies Best Suited to Different Ratios of Peak Volume to Uptown Boardings¹



Legend























range in which strategy can be effectively operated

range in which strategy is likely to be most promising

- 1 For inbound direction. When the peak direction is outbound, use the ratio of peak volume to uptown alightings (PV/UA). The same figures apply.
- 2 Can be operated inbound only.

Effect of Corridor Length on Choice of Local Operating Strategy

Strategy	4 mi. or less	4-6 mi.	6-9 mi.	9 mi. or more
Restricted Zonal				
Semi- Restricted Zonal				
Limited-Stop Zonal				
Overlapping Local				
Skip-Stop				

Legend

	discourages use of strategy		neutral
	strongly encourages use of strategy		strongly encourages use of strategy