

IV. Network and Route Design

Public Transport Planning and Regulation: An Introduction



Planning and Analysis Building Blocks



Schedule Building	Cost Analysis and Financial Planning
Performance Analysis	
Measures & Standards	Service Monitoring and Data Collection
Network and Route Design	Fares and Revenue: Policy, Analysis, and Collection
Market Factors and Demand Analysis	Terminology and Basic Relationships

Focus of Discussion

Network and Route Design

- **Public transport services tend to evolve over time as cities grow and markets change**
 - **Usually, they have not been planned as an integrated network**
- **Complex travel patterns require that individual routes be designed to form an integrated network**
- **Individual routes should be designed to serve specific markets**

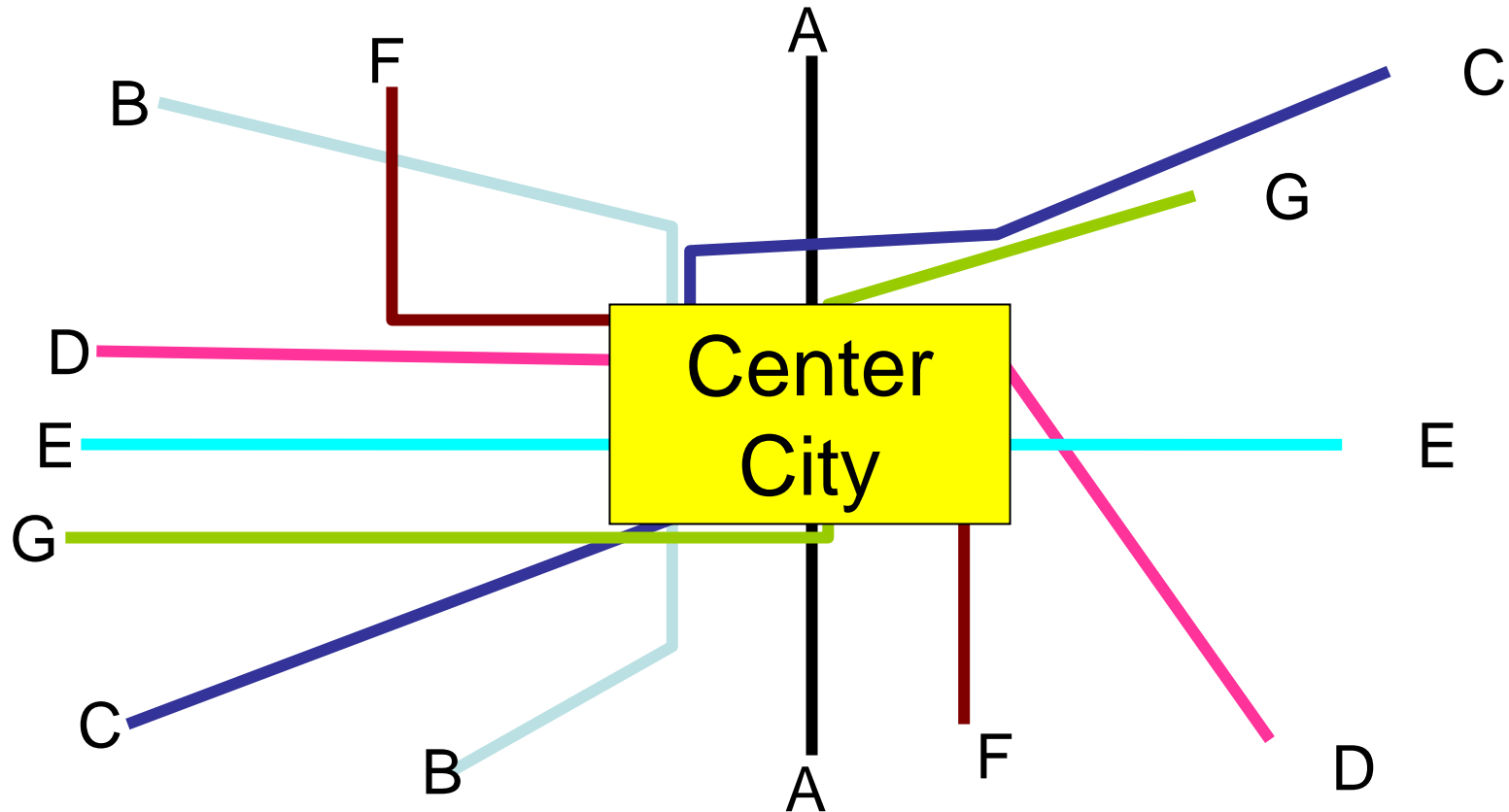


Network Structures

- Radial
- Grid
- Hierarchical
 - Trunk-Feeder



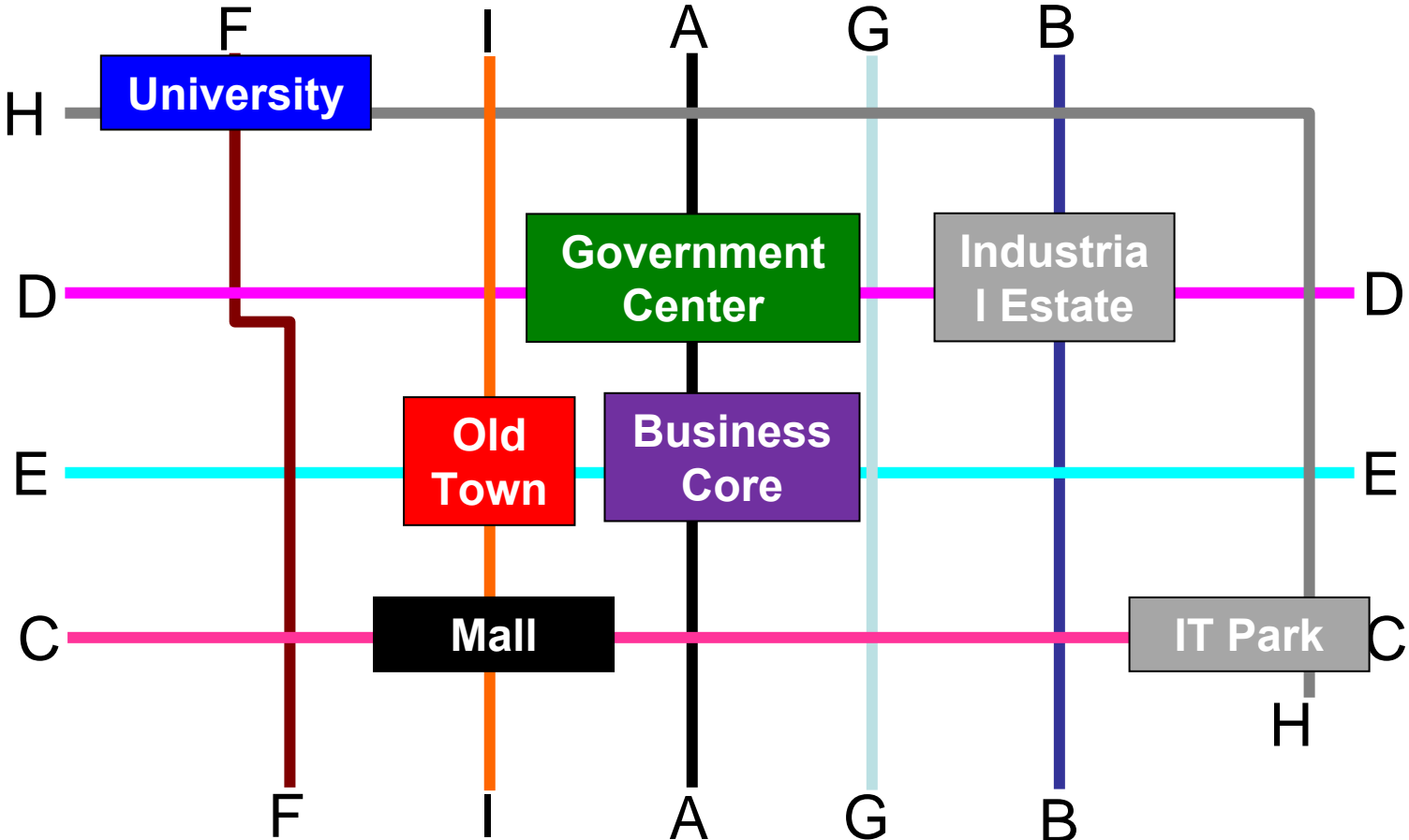
Radial Network



Traditional structure focused on a single dominant activity center



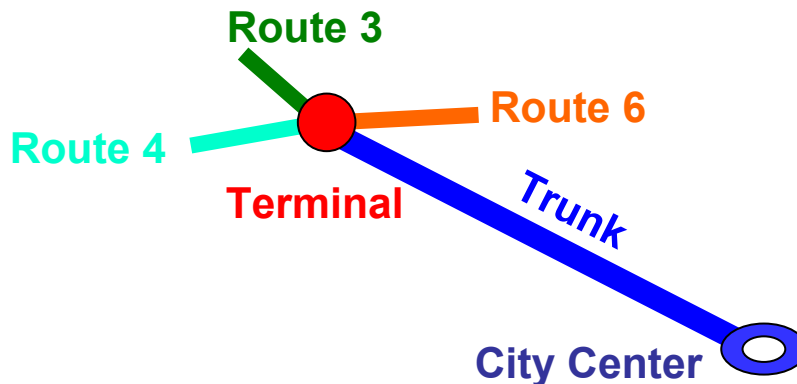
Grid Network



Provides direct access to many destinations with no more than one transfer

Hierarchical “Trunk-Feeder”

- Different types of routes perform different functions
 - Feeder: Collection/distribution (e.g., barrios)
 - Trunk: Long distance, major destinations (e.g., City Center)
- Generally, higher service frequencies and larger vehicles on trunk routes





Trunk-Feeder Schedule Coordination



- **Easy for *Feeder-to-Trunk* movement since trunk frequencies are typically higher than feeder frequencies**
- **Difficult for *Trunk-to-Feeder* movement since trunk users may just miss a lower-frequency feeder bus**
 - **Very reliable trunk service may help since users can plan their trunk trip to meet the feeder departure**



Feeder Route Crowding

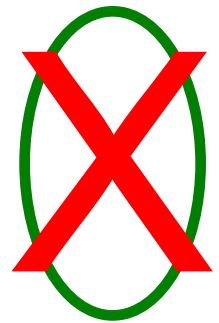
- **Not an issue for Feeder-to-Trunk movements**
 - **Easier to schedule adequate feeder capacity**
- **Difficult issue for Trunk-to-Feeder since large trunk loads may arrive and exceed feeder (and possibly terminal) capacity**
 - **Important to monitor trip-by-trip loadings and design appropriate service (e.g., irregular intervals, doubleheader buses)**
 - **Real-time dispatching and adjustments can address immediate problems**



Feeder Route Design



Terminal



Terminal

- **Linear routes are preferable to loop routes**
- **One-way loop routes require users to travel more than halfway around the loop either going to or coming from terminal**
- **Short loops minimize this problem**



Setting Feeder Intervals

- **Setting feeder intervals based on demand may result in inconvenient service**
 - **Inconsistent with user needs**
 - **Long waits**
- **Minimum policy intervals may be needed to provide convenient service**
- **Policy intervals may result in low productivity feeder routes**
- **Important to view the trunk and feeder routes as one product**



Types of Routes

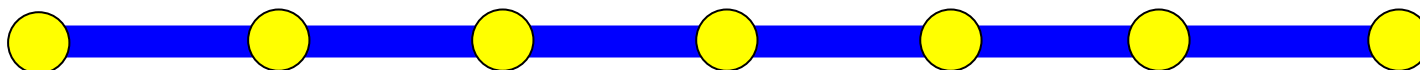
- **Local**
 - **Partial Service**
 - **Branching**
- **Limited Stop**
- **Express**



Local Service

- **Approach**

- **Service provided to each designated stop on route**
- **All trips operate entire length of route**



Suburb	A	B	C	D	E	City
7:00 AM	7:10 AM	7:18 AM	7:26 AM	7:35 AM	7:45 AM	7:53 AM
7:10 AM	7:20 AM	7:28 AM	7:36 AM	7:45 AM	7:55 AM	8:03 AM
7:20 AM	7:30 AM	7:38 AM	7:46 AM	7:55 AM	8:05 AM	8:13 AM
7:30 AM	7:40 AM	7:48 AM	7:56 AM	8:05 AM	8:15 AM	8:23 AM
7:40 AM	7:50 AM	7:58 AM	8:06 AM	8:15 AM	8:25 AM	8:33 AM





Importance of Designated Stops

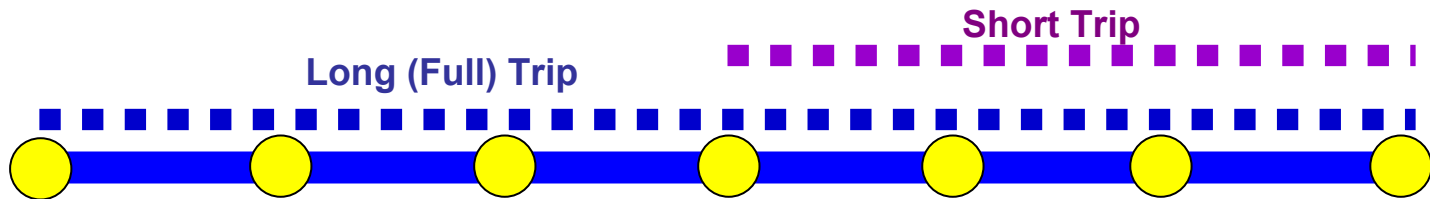
- **User**
 - Communicates passenger information on availability of service
 - Can provide passenger information on routes/schedules
 - Can provide passenger amenities (e.g., shelters, lighting)
 - Facilitates passenger interchanges
- **Operator**
 - By combining loading points, operating speed increases
- **General Public**
 - Improves traffic safety (buses, cars, pedestrians)
 - Improves traffic flow
 - Facilitates service monitoring and data collection



Partial Service

- **Approach**

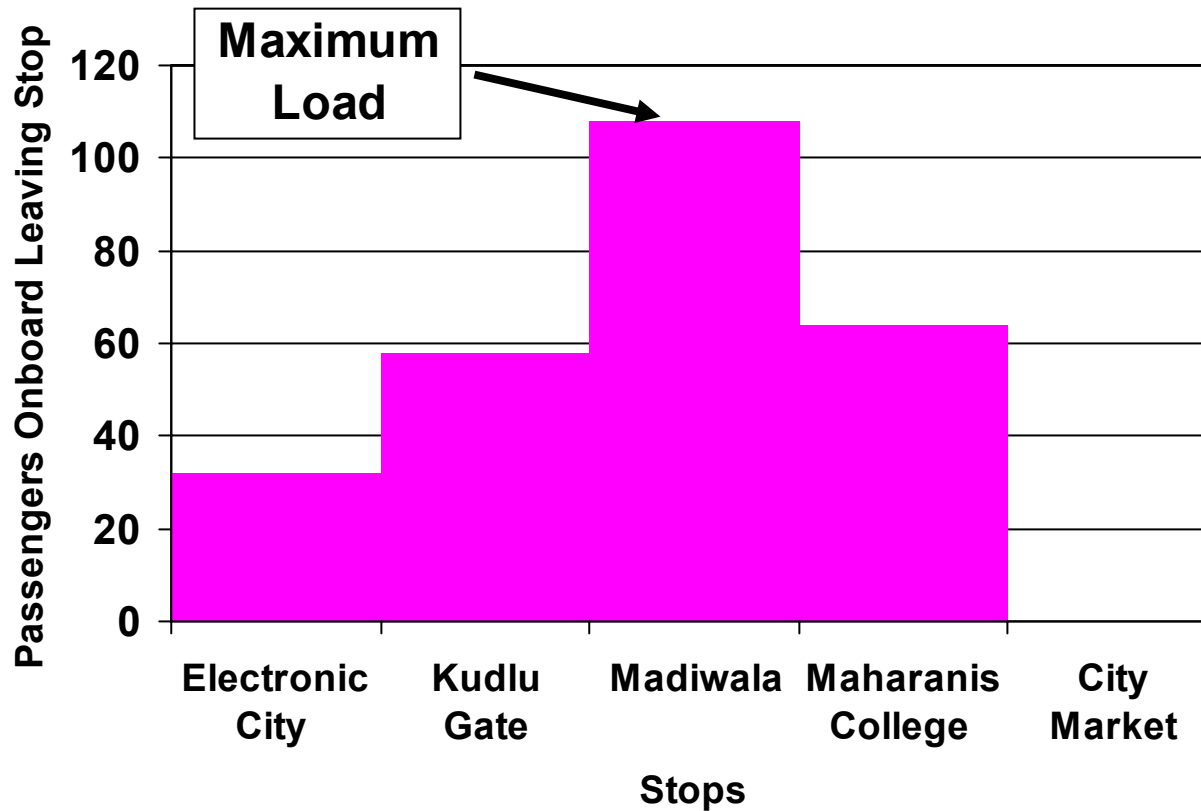
- Service provided to each stop on route
- Only some trips operate entire length of route



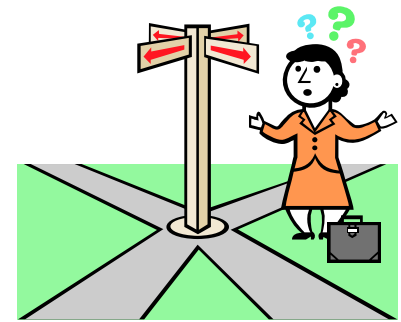
Suburb	A	B	C	D	E	City
7:00 AM	7:10 AM	7:18 AM	7:26 AM	7:35 AM	7:45 AM	7:53 AM
			7:34 AM	7:43 AM	7:53 AM	8:01 AM
7:15 AM	7:25 AM	7:33 AM	7:41 AM	7:50 AM	8:00 AM	8:08 AM
			7:49 AM	7:58 AM	8:08 AM	8:16 AM
7:30 AM	7:40 AM	7:48 AM	7:56 AM	8:05 AM	8:15 AM	8:23 AM



Load Profile Data Essential for Effective Design



Partial Service



- **Advantage: Match supply and demand**
- **Disadvantage: Passenger confusion on outbound trips (e.g., to Suburb)**

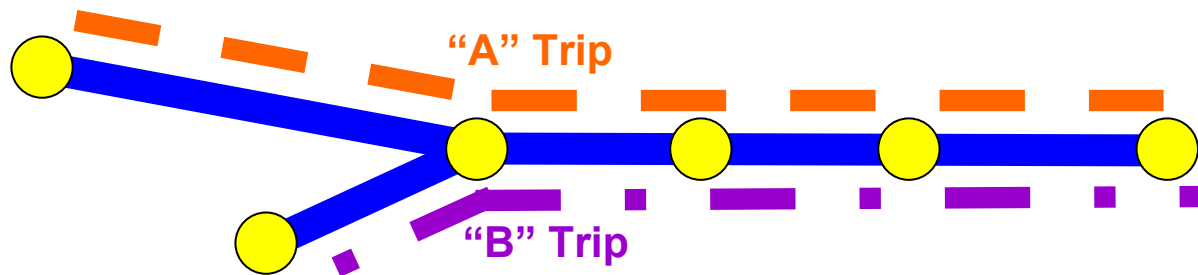
Suburb	A	B	C	D	E	City
7:00 AM	7:10 AM	7:18 AM	7:26 AM	7:35 AM	7:45 AM	7:53 AM
			7:34 AM	7:43 AM	7:53 AM	8:01 AM
7:15 AM	7:25 AM	7:33 AM	7:41 AM	7:50 AM	8:00 AM	8:08 AM
			7:49 AM	7:58 AM	8:08 AM	8:16 AM
7:30 AM	7:40 AM	7:48 AM	7:56 AM	8:05 AM	8:15 AM	8:23 AM



Local Service: Route Branching

- Approach

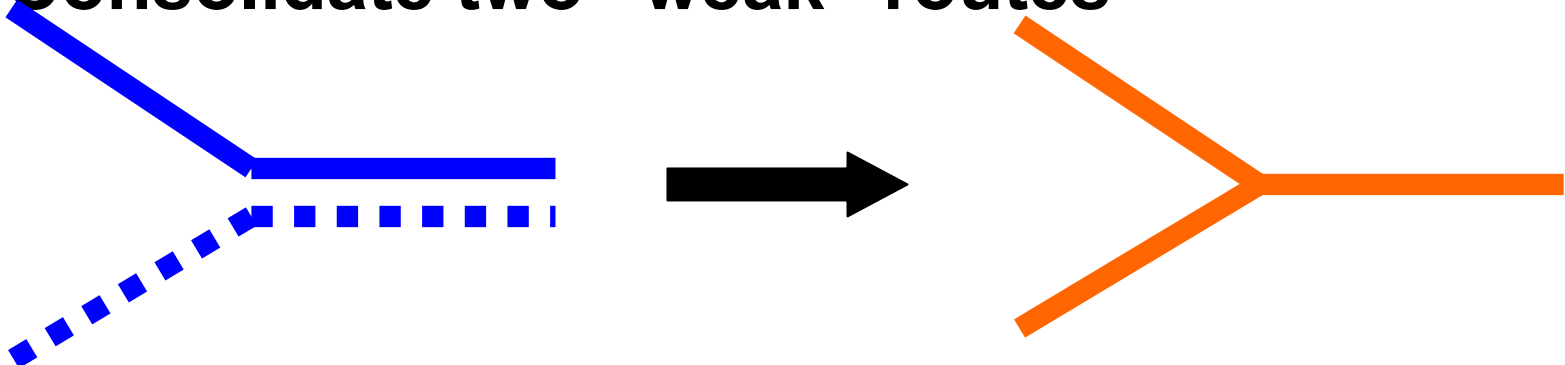
- Service provided to each stop along the route “trunk”
- Trips alternate to the outer “branches”



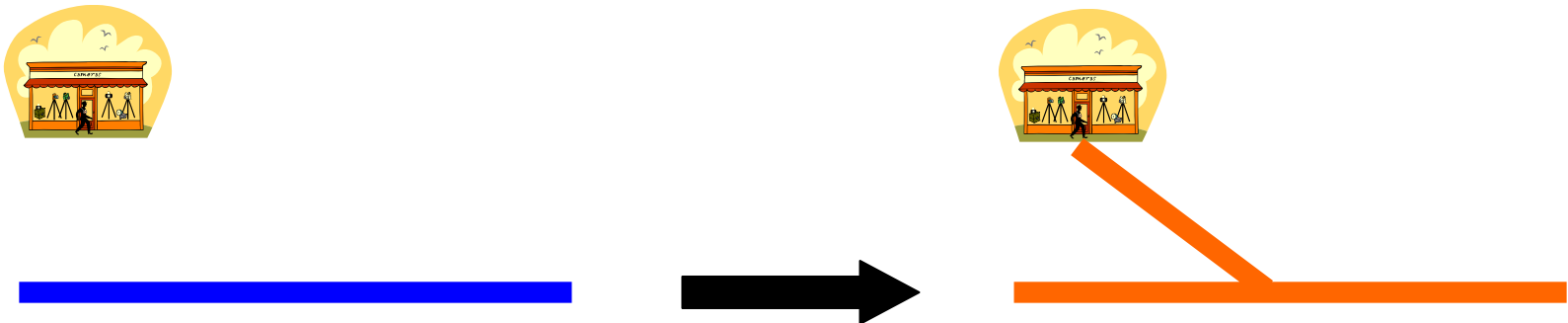
A	B	C	D	E	City Market
7:00 AM		7:20 AM	7:29 AM	7:39 AM	7:47 AM
	7:05 AM	7:25 AM	7:34 AM	7:44 AM	7:52 AM
7:10 AM		7:30 AM	7:39 AM	7:49 AM	7:57 AM
	7:15 AM	7:35 AM	7:44 AM	7:54 AM	8:02 AM
7:20 AM		7:40 AM	7:49 AM	7:59 AM	8:07 AM
	7:25 AM	7:45 AM	7:54 AM	8:04 AM	8:12 AM

Reasons for Route Branching

- Consolidate two “weak” routes



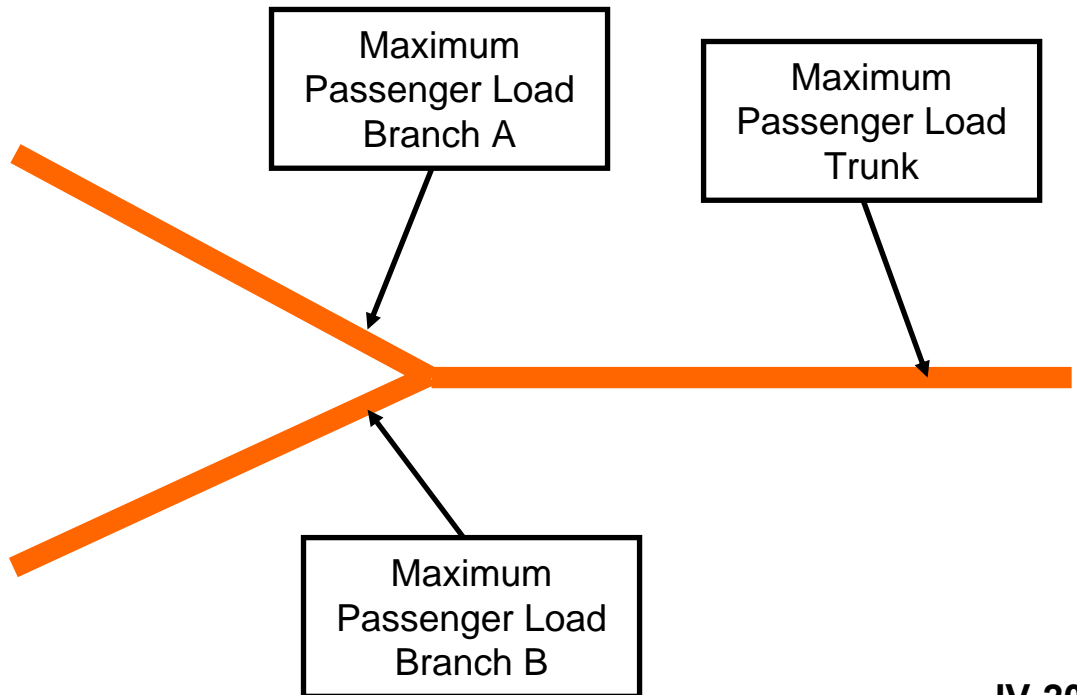
- Provide service to new origins or destinations



Load Profile Data Essential for Designing Effective Branches

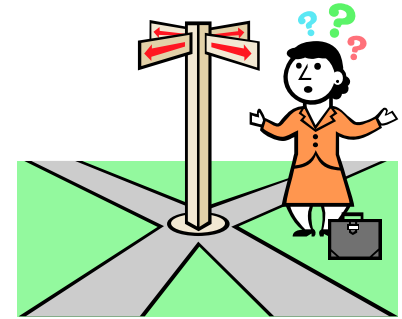
- **Must insure that there is sufficient vehicle capacity to serve passenger demand on:**

- **Each branch**
- **The trunk**



Route Branching

- **Advantage**
 - Match supply and demand
- **Disadvantage**
 - Passenger confusion on outbound trips to a branch (e.g., to A)
 - Possible “bunching” on trunk



A	B	C	D	E	City Market
7:00 AM		7:20 AM	7:29 AM	7:39 AM	7:47 AM
	7:05 AM	7:25 AM	7:34 AM	7:44 AM	7:52 AM
7:10 AM		7:30 AM	7:39 AM	7:49 AM	7:57 AM
	7:15 AM	7:35 AM	7:44 AM	7:54 AM	8:02 AM
7:20 AM		7:40 AM	7:49 AM	7:59 AM	8:07 AM
	7:25 AM	7:45 AM	7:54 AM	8:04 AM	8:12 AM



Making Branches Less Confusing?

- *“Label each branch a separate route”*
- **Disadvantage: Makes it difficult to provide information to passengers with origins and destinations on the trunk**
(e.g., **Bangalore has over 1,700 routes**)

Limited Service

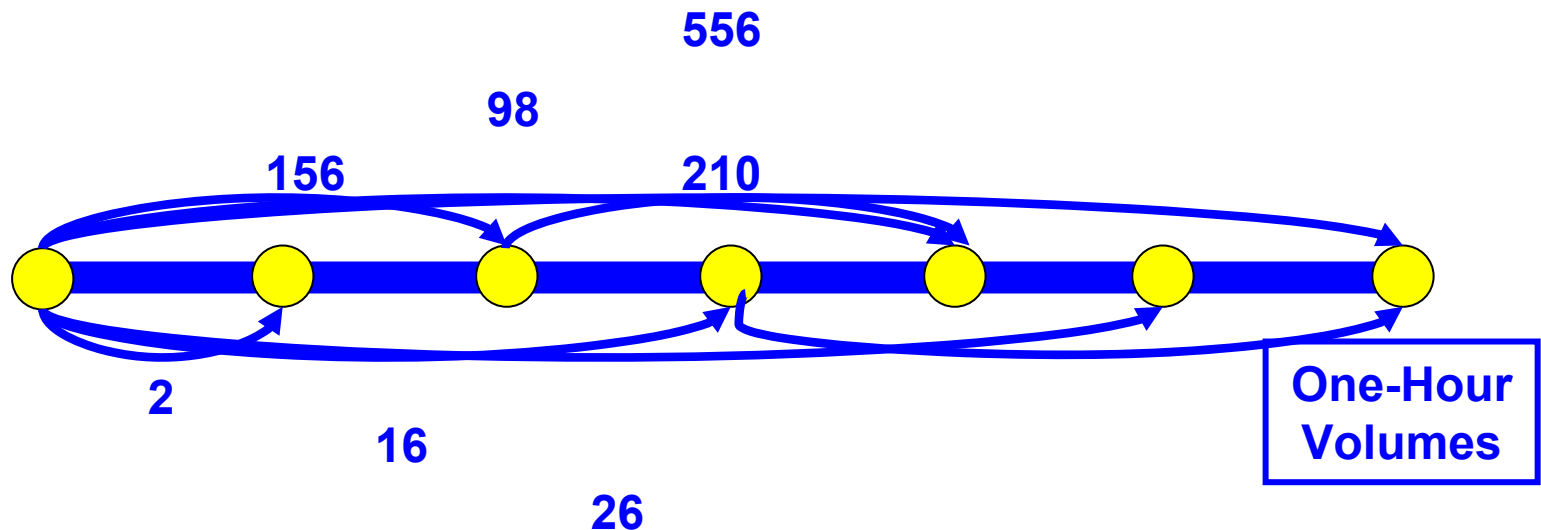
- **Approach**
 - **Service provided to selected stops on route**
 - High passenger boardings and alightings
 - **All trips operate entire length of route**
 - **Usually supplements local service**



Electronic City	A	B	C	D	E	City Market
7:00 AM		7:14 AM		7:29 AM		7:45 AM
7:15 AM		7:29 AM		7:44 AM		8:00 AM
7:30 AM		7:44 AM		7:59 AM		8:15 AM
7:45 AM		7:59 AM		8:14 AM		8:30 AM
8:00 AM		8:14 AM		8:29 AM		8:45 AM

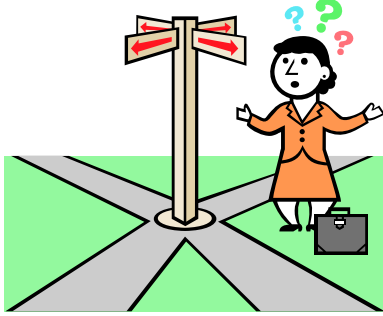


Origin-Destination Data Essential for Designing Limited Service



- **Boarding and alighting data may not be sufficient!**





Limited Service

- **Advantages**
 - **Improved passenger speed**
 - **Increased operator efficiency**
 - Frees up space on local buses and at stops
- **Disadvantage**
 - **Passenger confusion**
 - Catching correct bus inbound *and* outbound



Express Service

- **Approach**

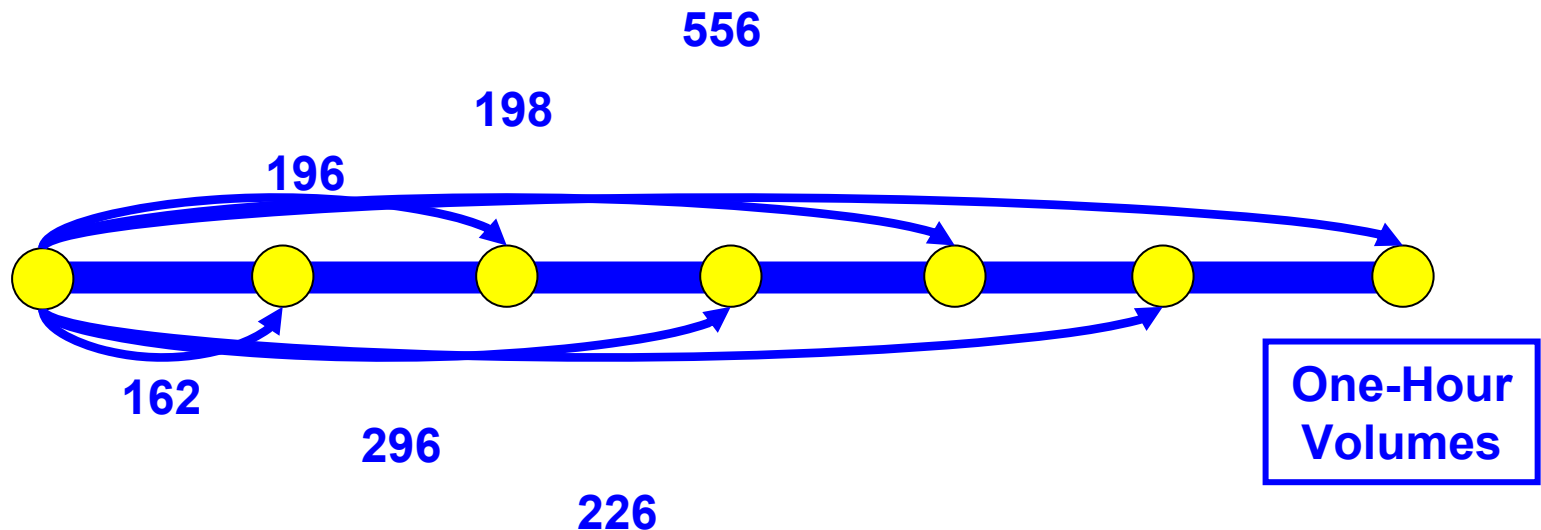
- **Non-stop service provided between stop(s) in outer area and stop(s) in central city or key destination**
- **All trips operate entire length of route**
- **Usually supplements local service**



Electronic City	A	B	C	D	E	City Market
7:00 AM						7:40 AM
7:20 AM						8:00 AM
7:40 AM						8:20 AM
8:00 AM						8:40 AM
8:20 AM						9:00 AM

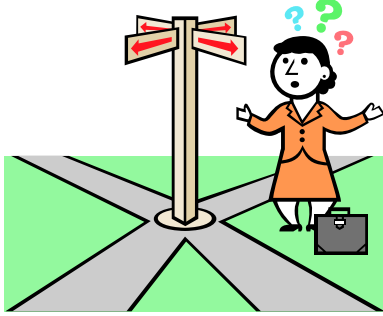


Origin-Destination Data Essential for Designing Express Service



- **Boarding and alighting data may not be sufficient**





Express Service

- **Advantages**
 - **Improved passenger speed**
 - **Increased operator efficiency**
 - Frees up space on local buses and at stops
- **Disadvantage**
 - **Passenger confusion**
 - Catching correct bus inbound *and* outbound
 - **Possible decreased operator efficiency**
 - No passenger turnover, may only get one bus trip per peak period





Keep in Mind

- From passenger perspective, *simplicity is a virtue!*
 - No more than 4 distinct services at any stop other than major passenger interchanges or destinations
 - Unique numbering of route variations (e.g., local, limited, express) may still cause passenger confusion
- From an operator perspective, too many routes at a stop may cause delays (buses waiting) and increase costs





Summary

- Described a wide range of service types
- ***Remember***, good planning requires:
 - Consideration of a variety of service types— there is no one *magic solution*
 - Good demand data on origin-destination flows

