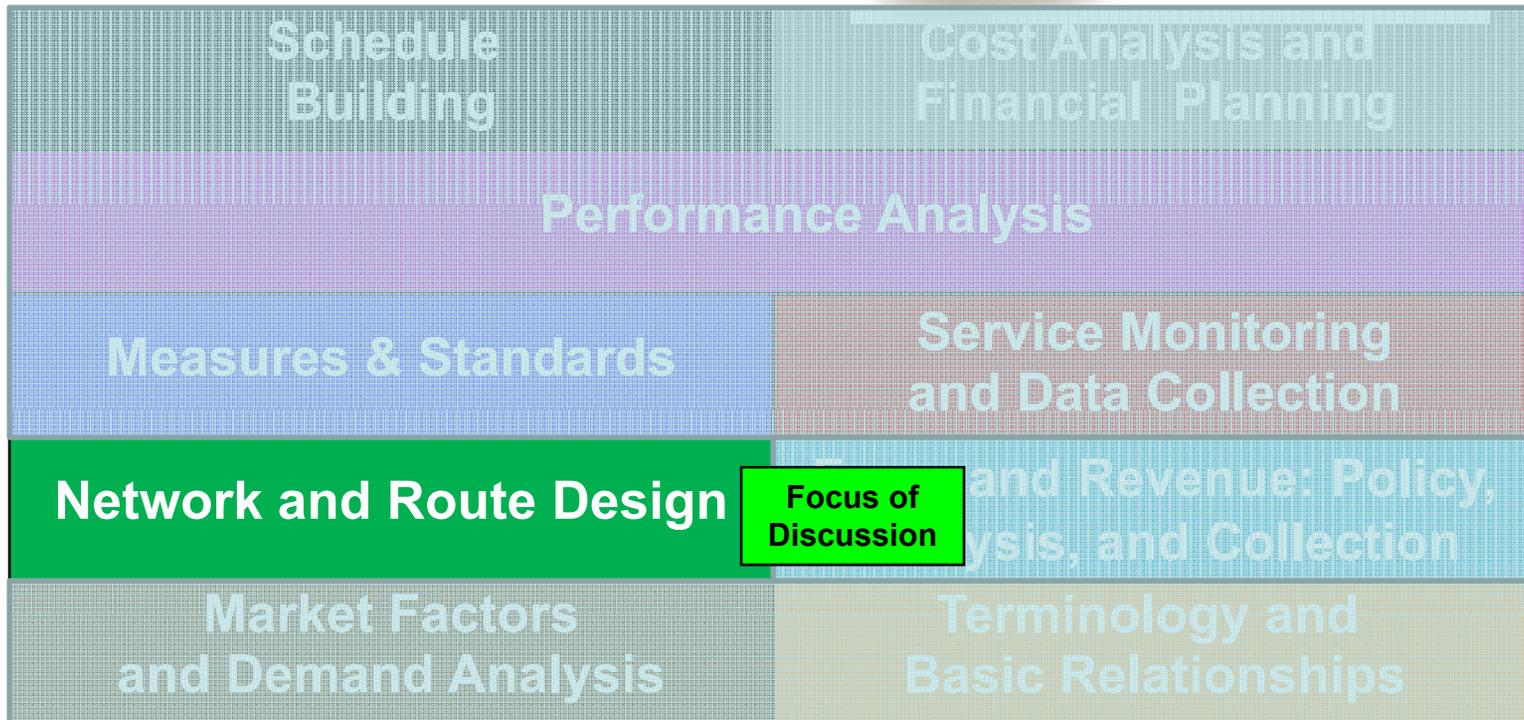


# IV. Network and Route Design

## *Public Transport Planning and Regulation: An Introduction*



# Planning and Analysis Building Blocks



# 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**

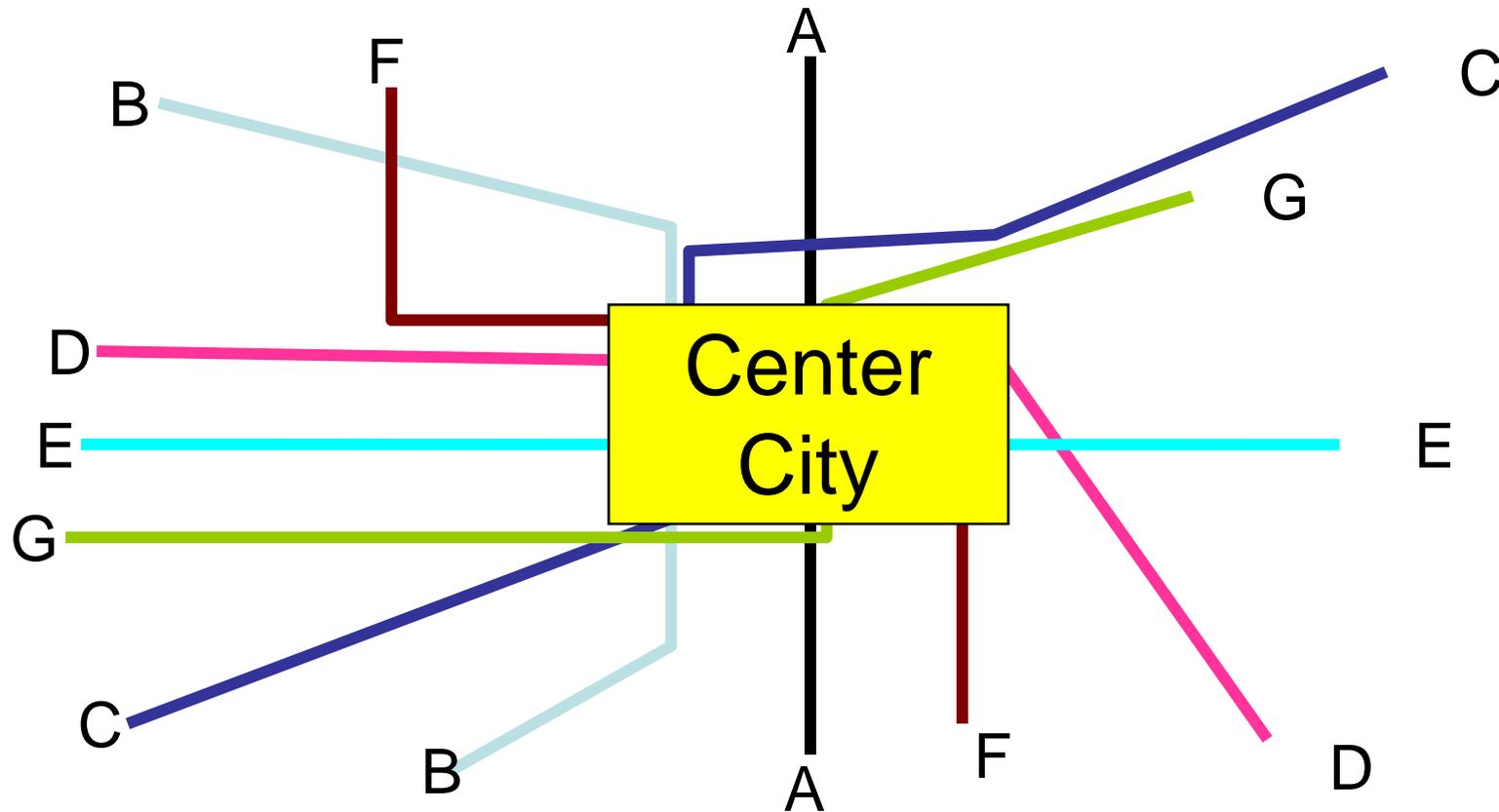


# Network Structures

- Radial
- Grid
- Hierarchical
  - Trunk-Feeder



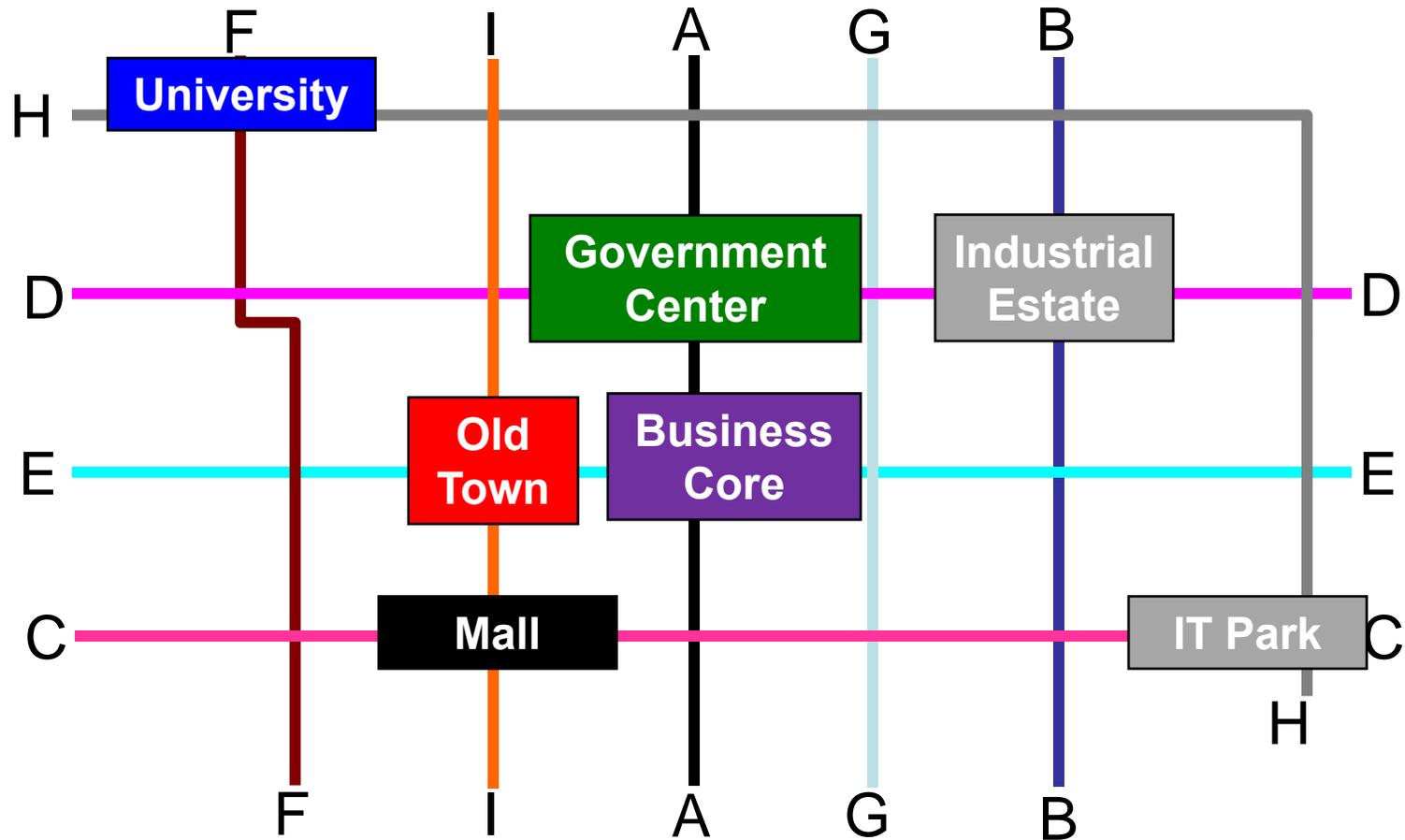
# Radial Network



**Traditional structure focused on a single dominant activity center**



# Grid Network

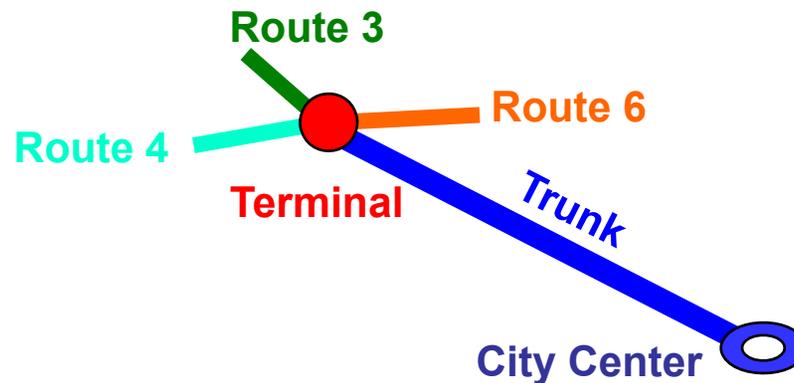


**Provides direct access to many destinations with no more than one transfer**



# 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

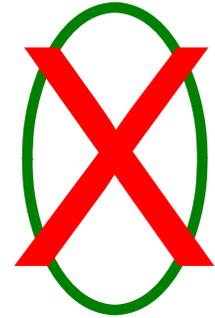
- **Not an issue for Feeder-to-Trunk movements**
  - **Easier to schedule adequate feeder capacity**
- **Difficult issue for Trunk-to-Feeder since large trunk loads may arrive and exceed feeder (and possibly terminal) capacity**
  - **Important to monitor trip-by-trip loadings and design appropriate 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**



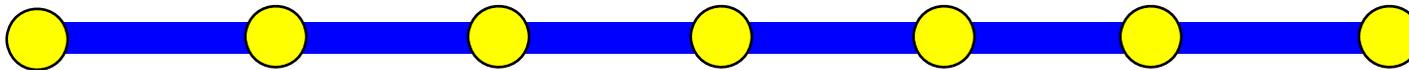
# Types of Routes

- **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



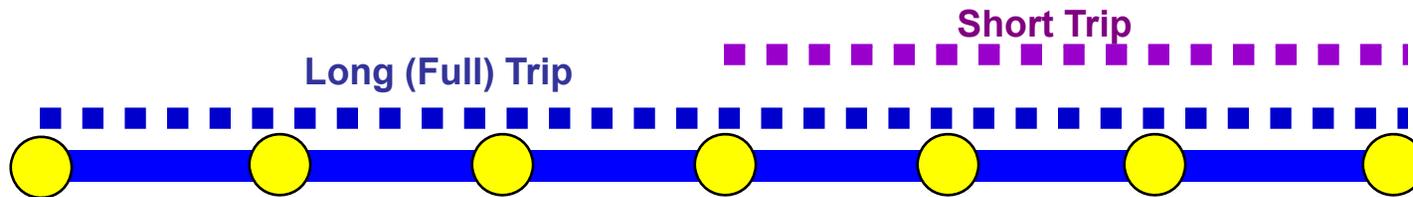
- **User**
  - Communicates passenger information on availability of service
  - Can provide passenger information on routes/schedules
  - Can provide passenger amenities (e.g., shelters, lighting)
  - Facilitates passenger interchanges
- **Operator**
  - By combining loading points, operating speed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

IV-14



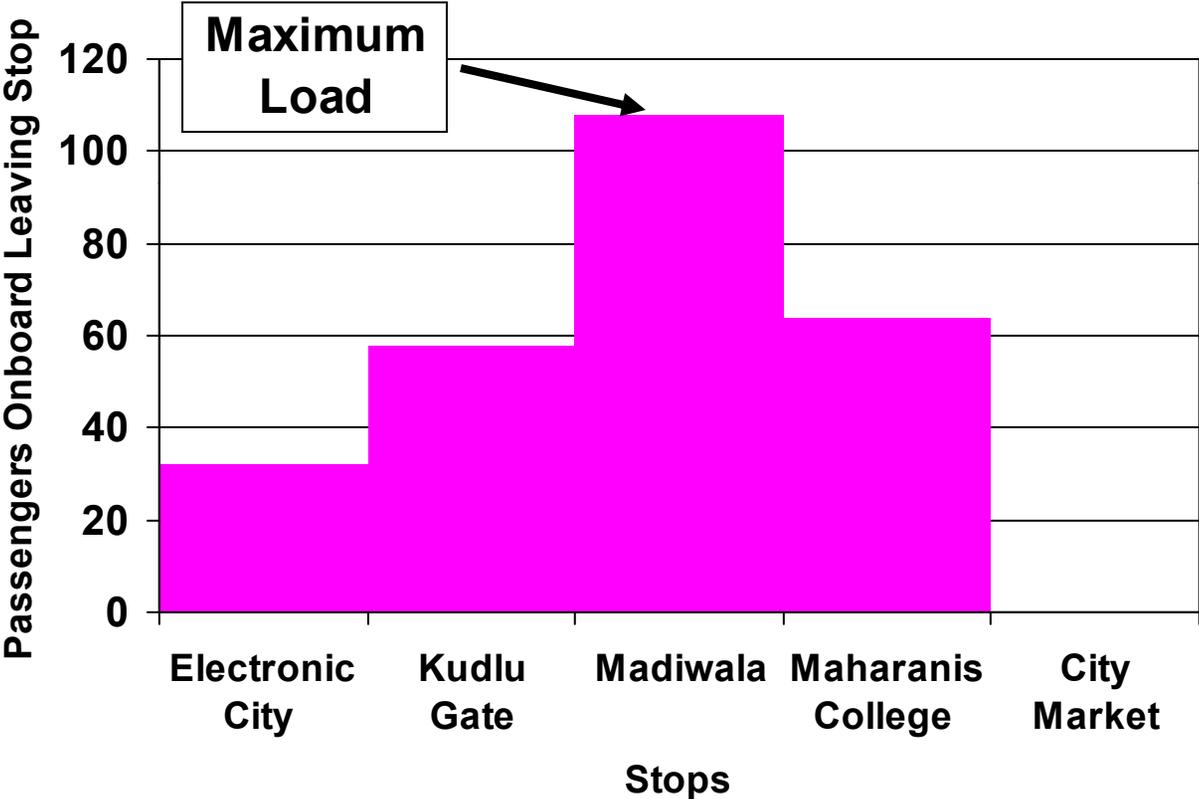
# Partial Service

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

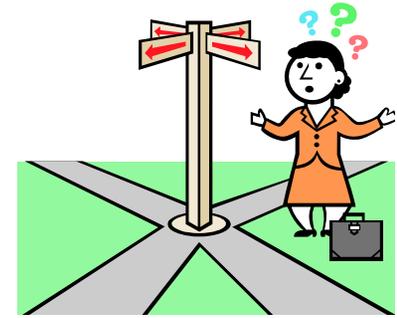


| Suburb  | A       | B       | C       | D       | E       | City    |
|---------|---------|---------|---------|---------|---------|---------|
| 7:00 AM | 7:10 AM | 7:18 AM | 7:26 AM | 7:35 AM | 7:45 AM | 7:53 AM |
|         |         |         | 7:34 AM | 7:43 AM | 7:53 AM | 8:01 AM |
| 7:15 AM | 7:25 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)**

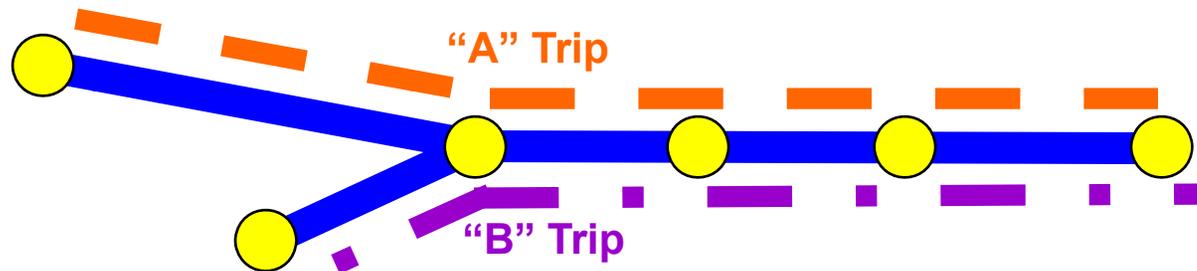
| Suburb  | A       | B       | C       | D       | E       | City    |
|---------|---------|---------|---------|---------|---------|---------|
| 7:00 AM | 7:10 AM | 7:18 AM | 7:26 AM | 7:35 AM | 7:45 AM | 7:53 AM |
|         |         |         | 7:34 AM | 7:43 AM | 7:53 AM | 8:01 AM |
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|         |         |         | 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**

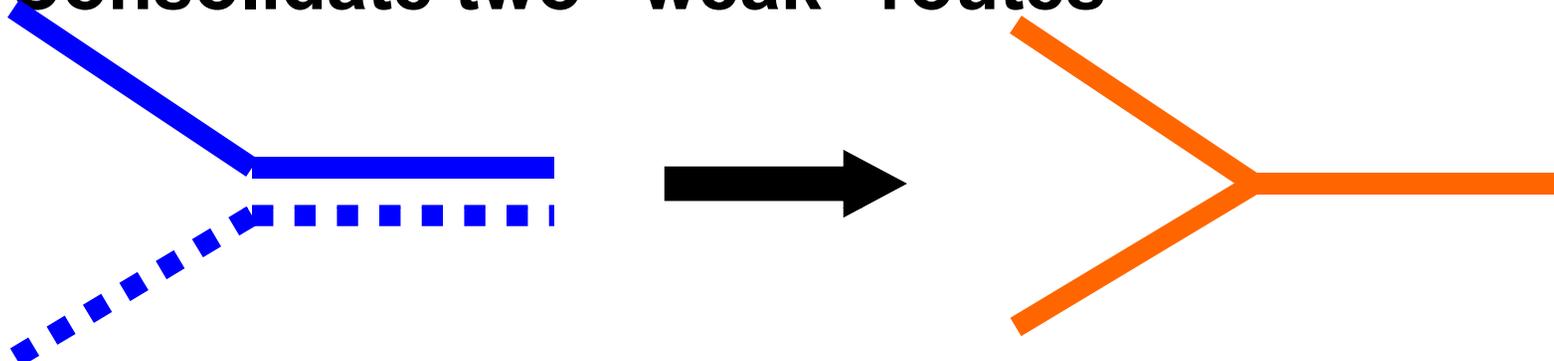
- Service provided to each stop along the route “trunk”
- Trips alternate to the outer “branches”



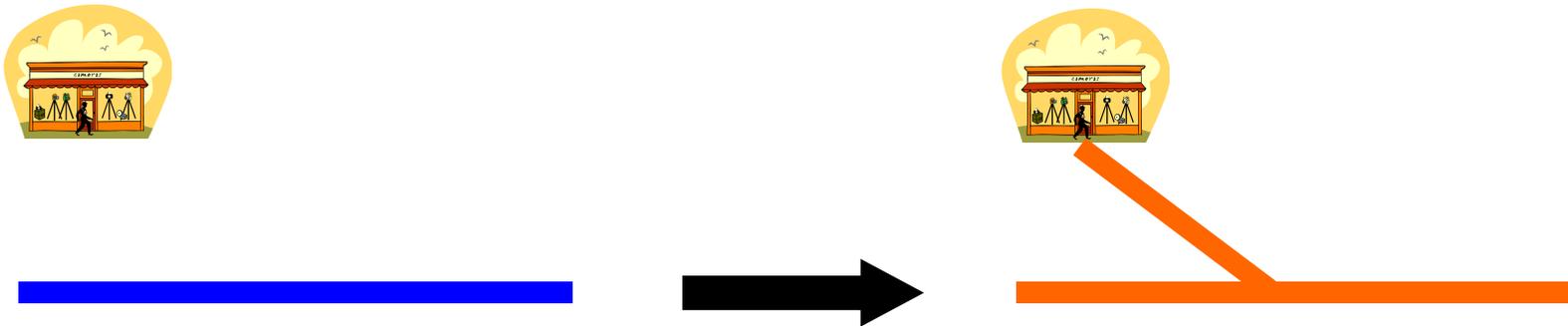
| A       | B       | C       | D       | E       | City Market |
|---------|---------|---------|---------|---------|-------------|
| 7:00 AM |         | 7:20 AM | 7:29 AM | 7:39 AM | 7:47 AM     |
|         | 7:05 AM | 7:25 AM | 7:34 AM | 7:44 AM | 7:52 AM     |
| 7:10 AM |         | 7:30 AM | 7:39 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



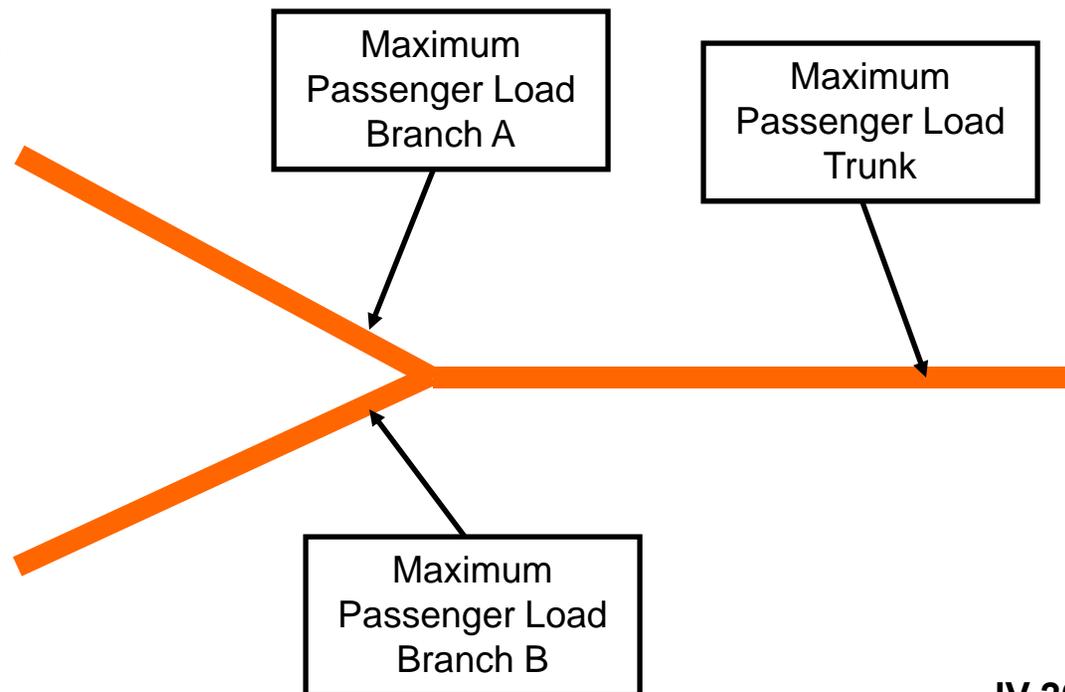
- Provide service to new origins or destinations



# Load Profile Data Essential for Designing Effective Branches

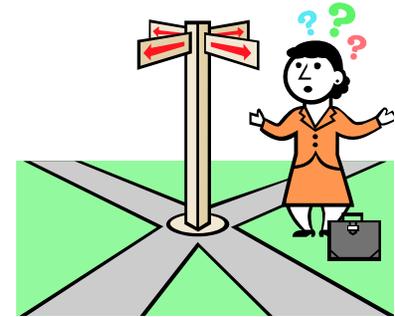
- **Must insure that there is sufficient vehicle capacity to serve passenger demand on:**

- **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

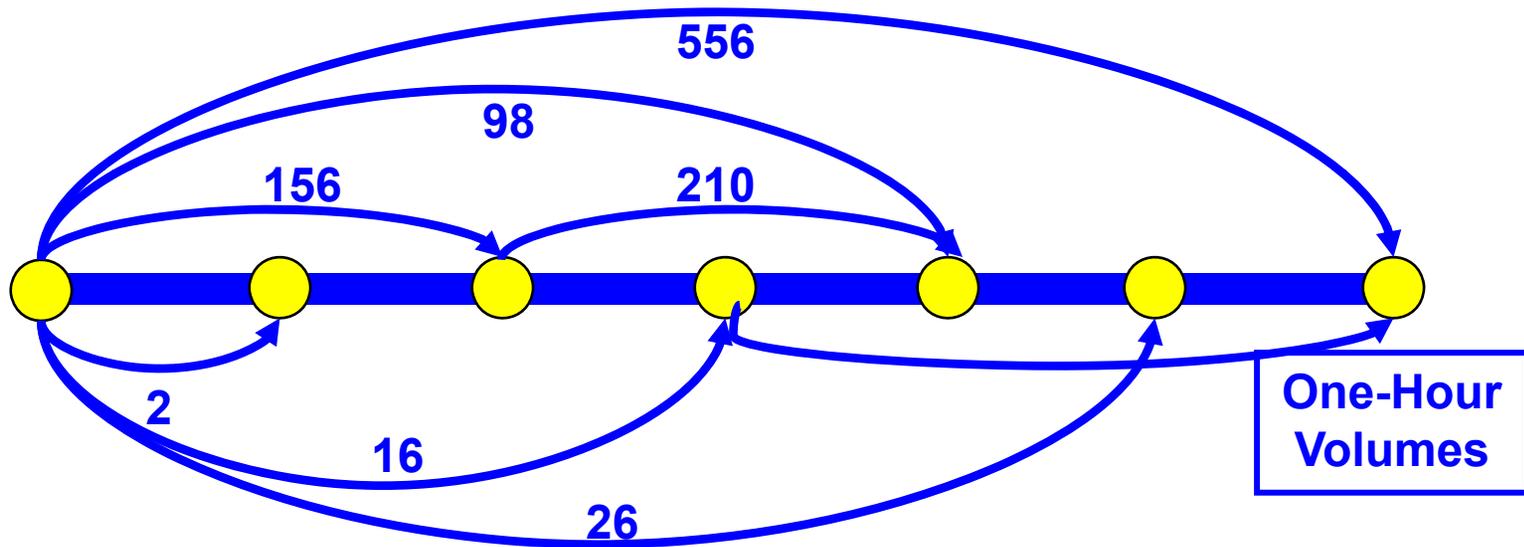
- **Approach**
  - **Service provided to selected stops on route**
    - High passenger boardings and alightings
  - **All trips operate entire length of route**
  - **Usually supplements local service**



| 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     |

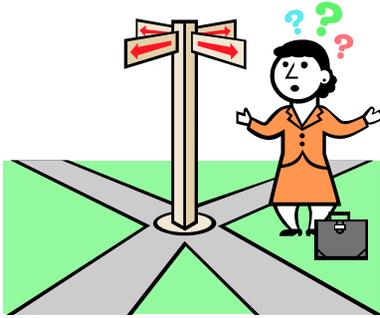


# Origin-Destination Data Essential for Designing Limited Service



- 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

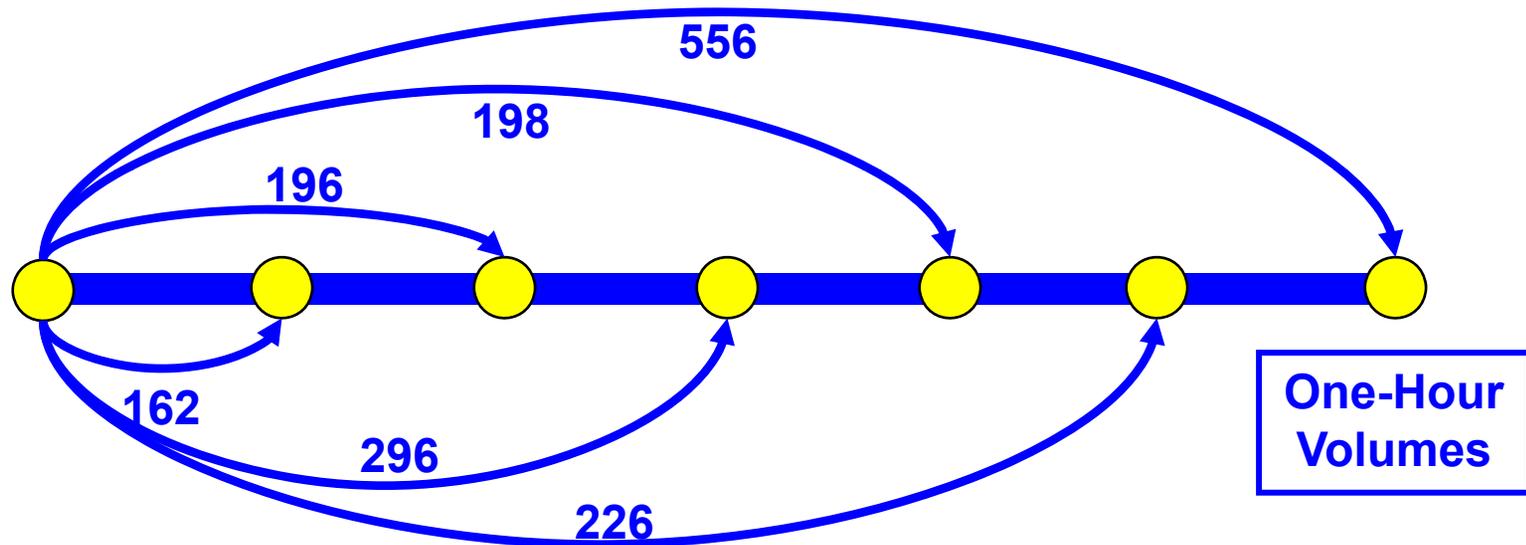
- **Approach**
  - **Non-stop service provided between stop(s) in outer area and stop(s) in central city or key destination**
  - **All trips operate entire length of route**
  - **Usually supplements local service**



| <b>Electronic City</b> | <b>A</b> | <b>B</b> | <b>C</b> | <b>D</b> | <b>E</b> | <b>City Market</b> |
|------------------------|----------|----------|----------|----------|----------|--------------------|
| 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            |

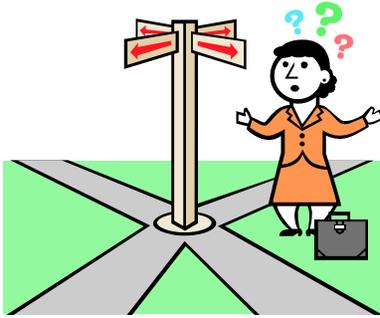


# Origin-Destination Data Essential for Designing Express Service



- **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

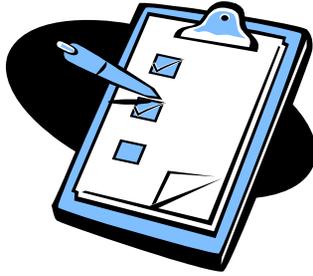




## Keep in Mind

- 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

