Introduction to Transportation Systems
PART I:
CONTEXT, CONCEPTS AND CHARACTERIZATION
Chapter 5:
Networks
Node and Link Network Representation

Figure 5.1
Networks

- Transportation networks are interconnected.
- We have connections between the links through the other basic network elements that are called nodes, which often represent terminals or stations.
- In most transportation cases, the network is redundant. There are usually multiple ways to travel between nodes.
Links

- *Links* are typically guideways, highways, rail lines, air corridors, etc.
- We have links that can take flows, typically of vehicles, in one or both directions.
- Links often have a *capacity* (e.g., vehicles/hour).
Capacity

Capacity defined as a link volume beyond which the travel time is infinite.

Figure 5.2
Link Travel Time: Another Idea

Figure 5.3
Hierarchical Networks

- Highways
  - Local Streets
  - Collector Streets
  - Arterial Streets
  - Expressway
Intermodal Network

Figure 5.4
Nodes

Nodes often represent:
- A terminal yard in a railroad operation
- An airport
- A parking lot

Nodes have a capacity limit also.
Node to Denote Link Change

2 Lanes

3 Lanes

PHYSICAL FACILITY

intermediate node

Link representing 2-lane section

Link representing 3-lane section

Figure 5.5
Mathematical Operations on Networks

Figure 5.6
Origin-Destination Matrix

$$
\begin{bmatrix}
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\
1 & 0 & f_{12} & f_{13} & f_{14} \\
2 & 0 & 0 & 0 & 0 \\
3 & 0 & 0 & 0 & 0 \\
4 & 0 & 0 & 0 & 0 \\
5 & 0 & 0 & 0 & 0 \\
6 & 0 & 0 & 0 & 0 \\
7 & 0 & 0 & 0 & 0 \\
8 & 0 & 0 & 0 & 0 \\
9 & 0 & 0 & 0 & 0 \\
\end{bmatrix}
$$

Figure 5.7
Traffic Assignment

- Assign traffic to shortest path between origin and destination
- All or nothing assignment
- Incremental assignment
Other Ideas

The inverse problem: estimating O-D flows from (measured) link flows.

“Logical” Links: Using a Link as a “Logical Connection”

Figure 5.8