Transportation III

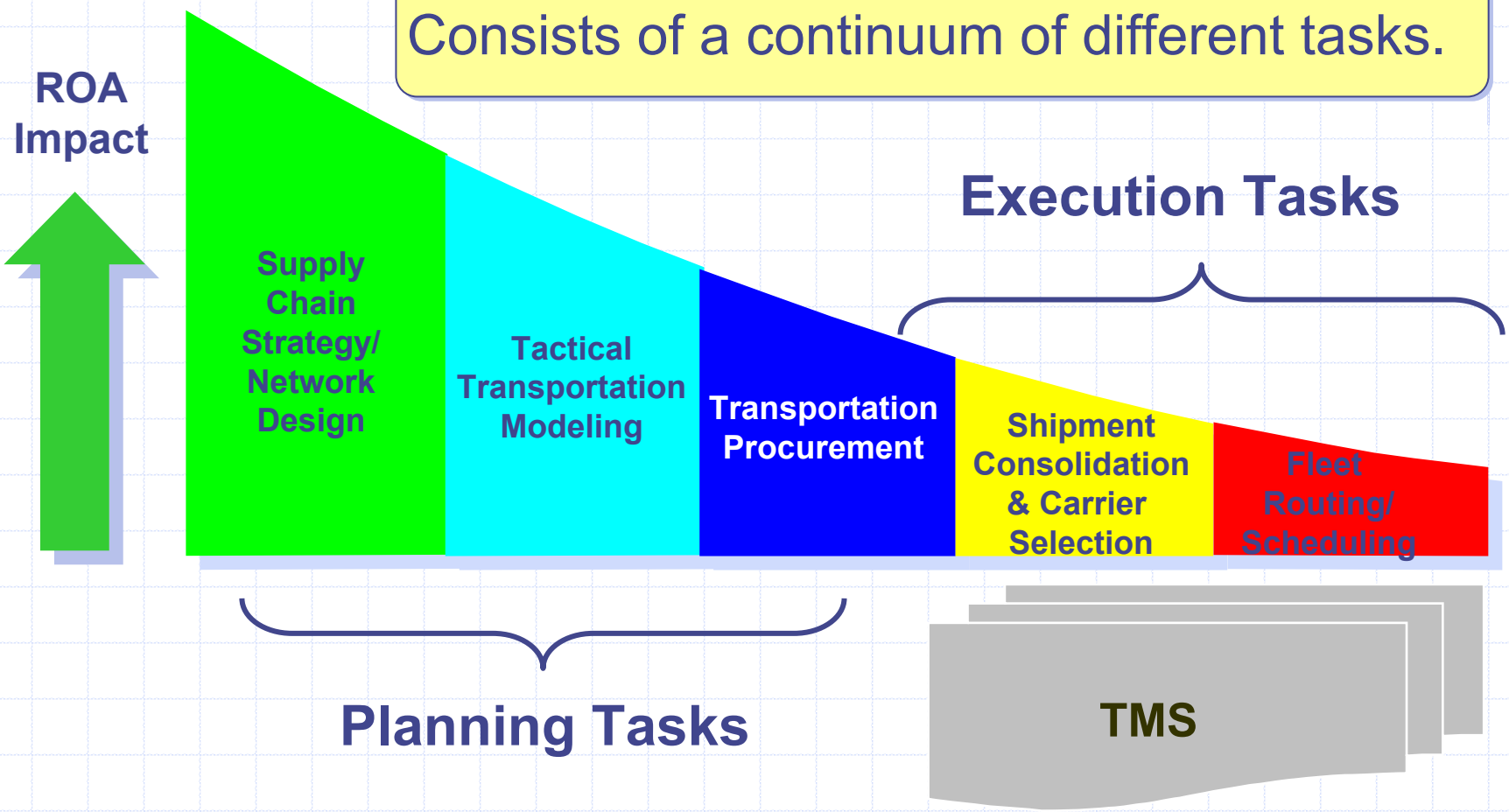
Transportation Management

Lecture 17
ESD.260 Fall 2003

Caplice

Transportation Management

Consists of a continuum of different tasks.



Questions Differ Based on Timeframe

Strategic

- What carriers should I partner with and how?
- How will seasonality affect my carrier assignments?
- Should I use dedicated or private fleets?
- Which carriers provided quality service in the past?
- Should I use pool points, cross-docks, or multi-stop routes?

Tactical

- How can I quickly secure rates for a new DC/plant/lane?
- What lanes are having performance problems?
- Which carriers are complying to or exceeding their contracts?
- Are site managers are complying to the strategic plan?
- Where should I establish a seasonal contract?

Operational

- Which carrier should I tender this load to?
- How can I collaboratively source this weeks' loads?
- How do I prevent Maverick/Rogue behavior?
- Should I use a contract carrier or look at the spot market?
- How can I best communicate with my carriers?

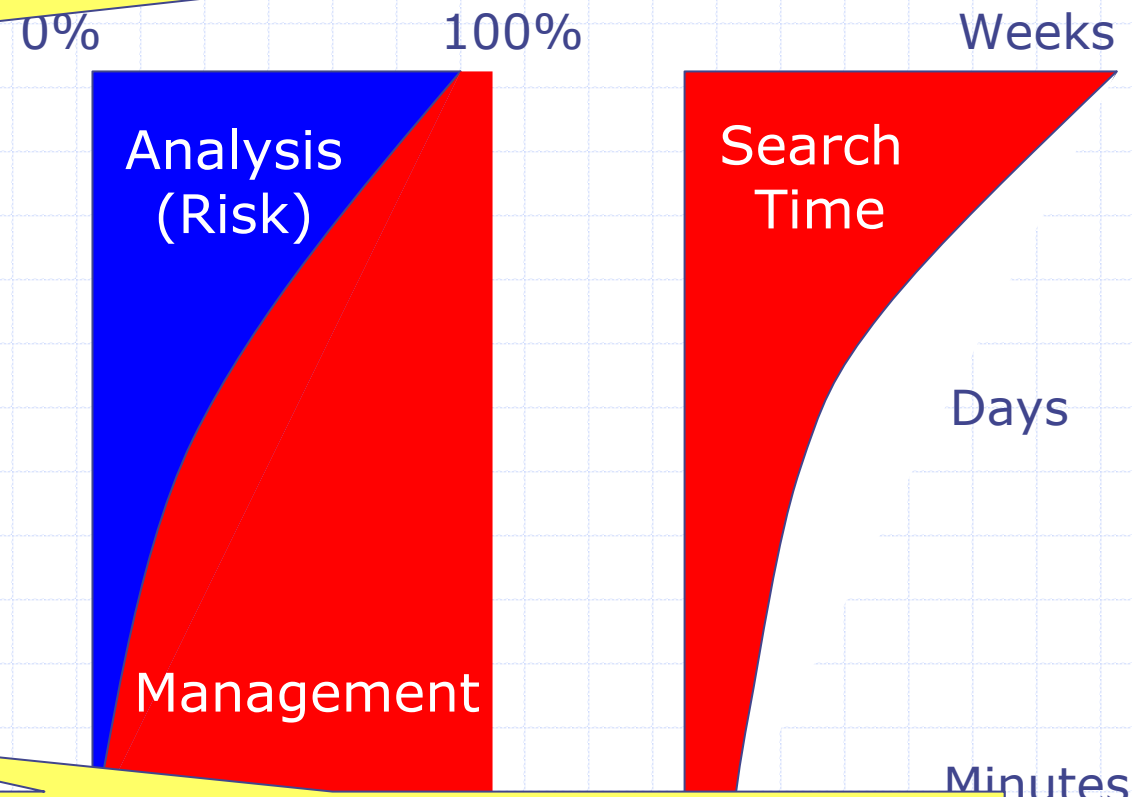
Approaches Differ Based on Timeframe

- Establishing plan & strategy
- Event based engagement
- Non-routine analysis - Value Focus

Strategic

Tactical

Operational

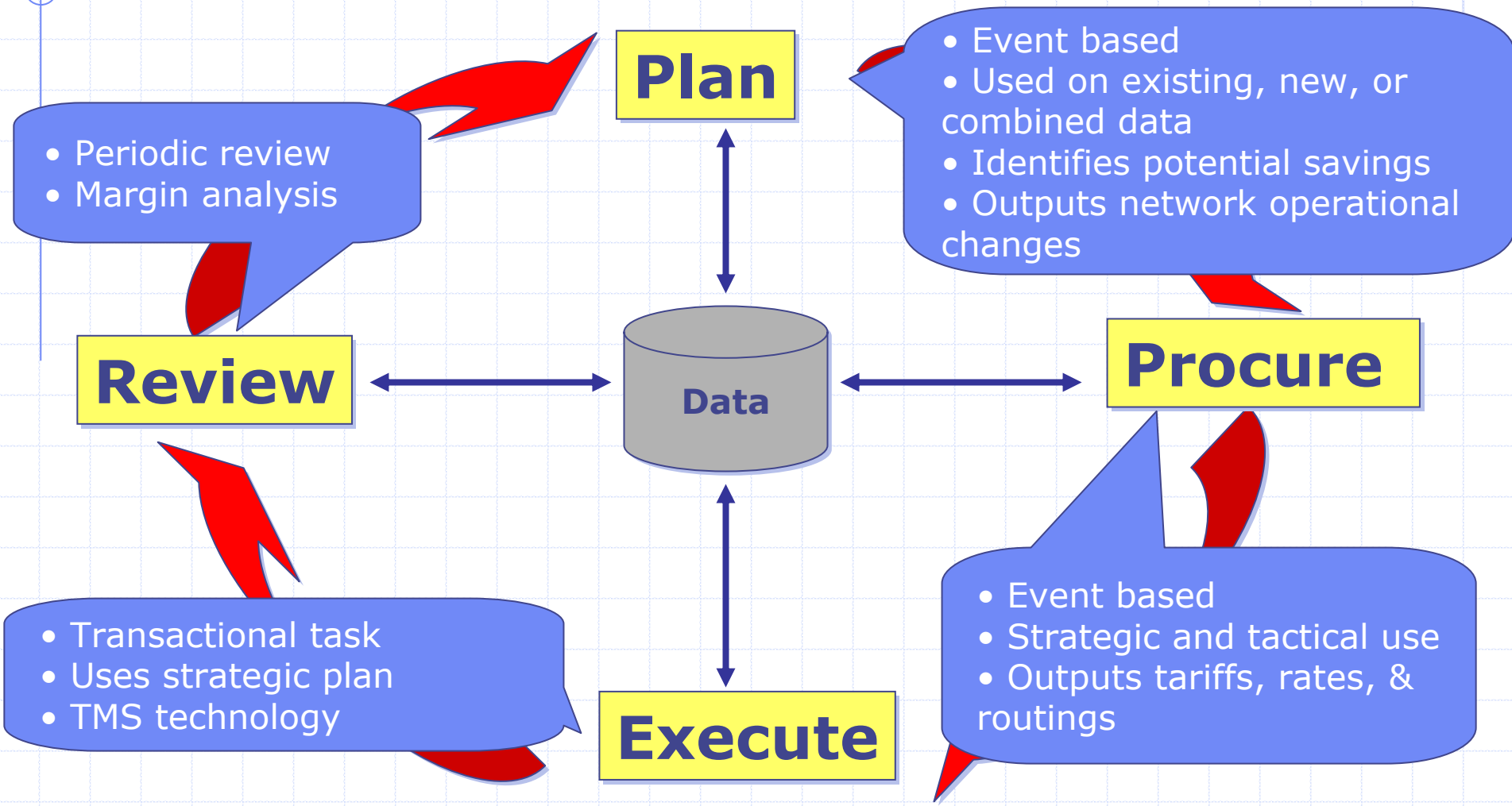


- Executing the strategic plan
- Transaction based rules & processes
- Automated actions - Process Focus

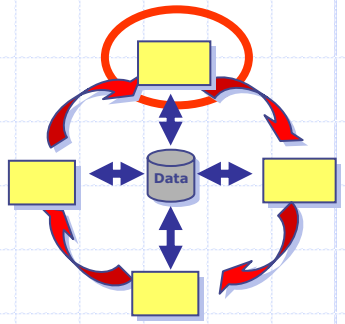
Technologies Differ Based on Timeframe

	Analysis Engine •Optimization •Simulation •Data Analysis	**Communication** •Web-based •File Exchange •Remote Access	**Workflow Software** •Compliance Tracking •Rules Engine •Transaction Processing
Strategic	X	X	
Tactical	X	X	
Operational	X	X	X

Unified Planning & Execution Process

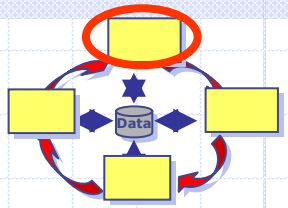


Transportation Planning



- Objective
  - Establish primary transportation modes, contract types, routing options to minimize total expected landed cost
- Key Points
  - Physical network (suppliers, plants, distribution centers) is likely already fixed
  - Plan is run annually with quarterly tweaks
  - Transportation plan limits what you can do in execution
  - Approximate approaches are acceptable, but we have lots of time so why not optimize . . . .

Decisions – Mode Choice

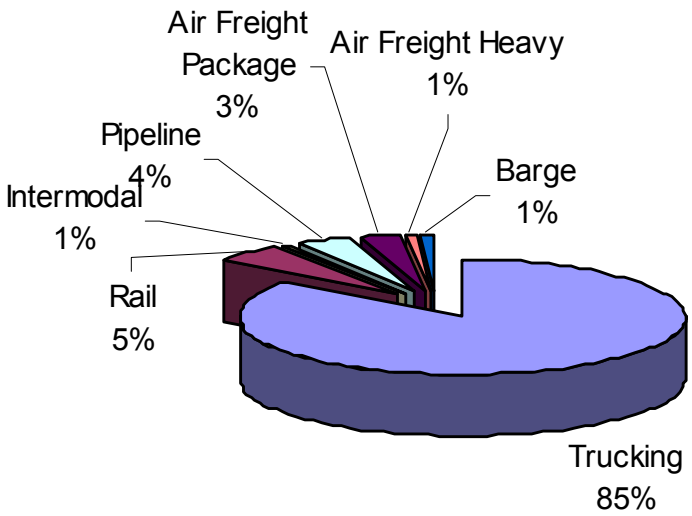


- Mode Choice Criteria
  - Feasibility
  - Service Standards
  - Length of Haul
  - Product Characteristics
  - Shipment Characteristics
- Trade-offs between
  - Service vs Cost
  - Inventory vs Transportation

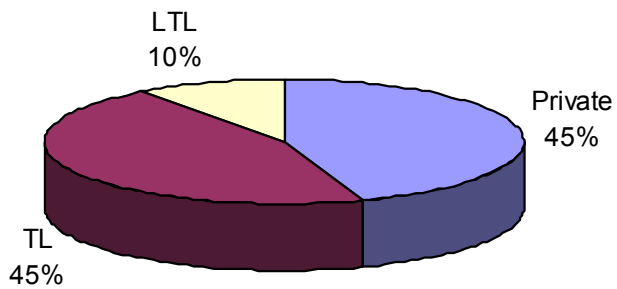
- Additional Choices
  - Types w/in Modes, e.g. Trucking
    - Truckload
    - Less-than-Truckload
    - Parcel
    - Expedited versus Standard
  - Intermodal / Multi-Modal
  - Dual-Mode Strategies
    - Air & Ocean
    - IM & Truck
    - LTL & TL
    - Air & Parcel

Mode	¢/ton-mile	Transit Time	Reliability (absolute)	Loss & Damage
Rail	2.28	3	4	5
Truck	26.19	2	3	4
Water	0.74	5	5	2
Pipeline	1.46	4	2	1
Air	61.2	1	1	3

Modal Shares 2001

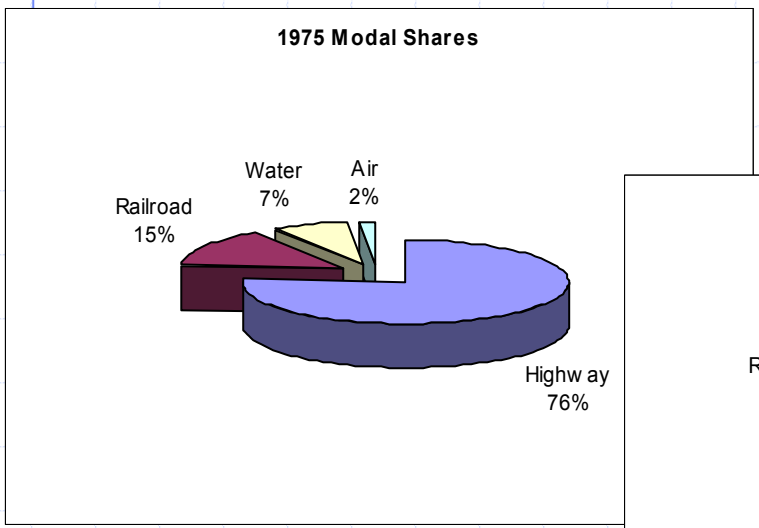


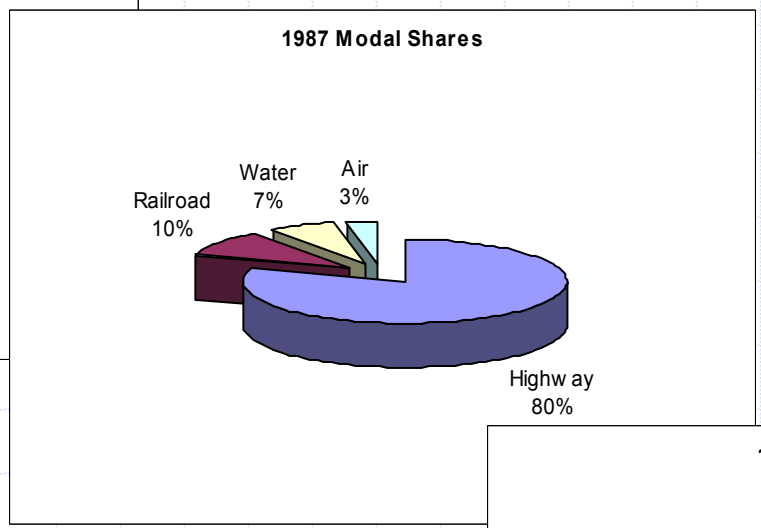
Mode	Ann Rev ($B)	Pct
Trucking	$ 610.2	86%
Rail	$ 35.4	5%
Intermodal	$ 6.7	1%
Pipeline	$ 27.2	4%
Air Freight Package	$ 20.0	3%
Air Freight Heavy	$ 6.0	1%
Barge	$ 8.1	1%
	$ 713.6	100%

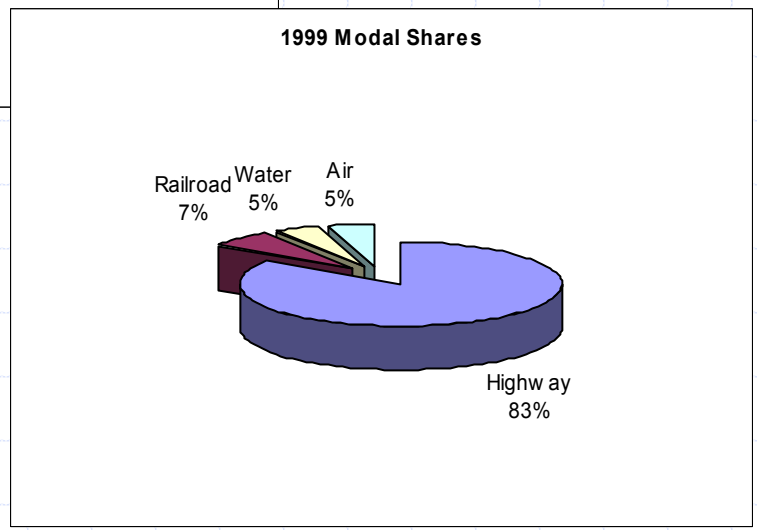


Trucking	Ann Rev ($B)
Private	$ 273.6
TL	$ 273.9
LTL	$ 62.7
	$ 610.2

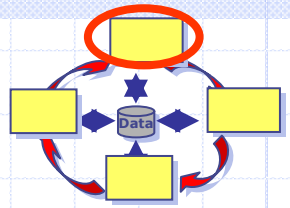
Modal Shares 1975 - 1999



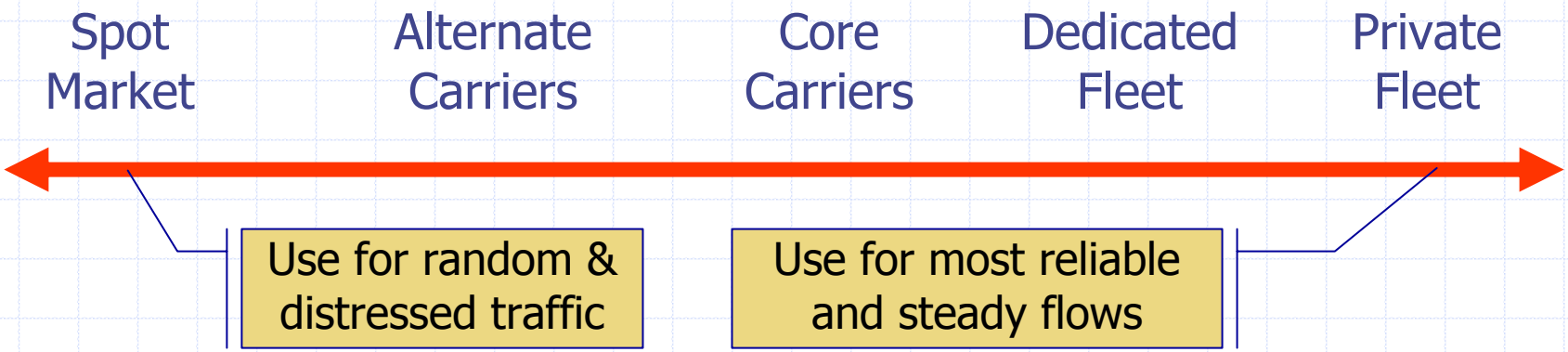




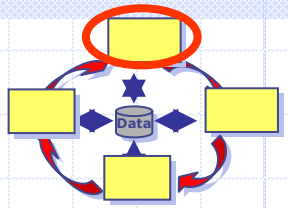
Decisions – Contract Type



- What type of relationship do you need to establish with your carriers?
- Continuum of relationships from one-off to ownership
  - Ownership of Assets versus Control of Assets
  - Responsibility for utilization
  - On-going commitment / responsibilities
  - Shared Risk/Reward – Flexible contracts

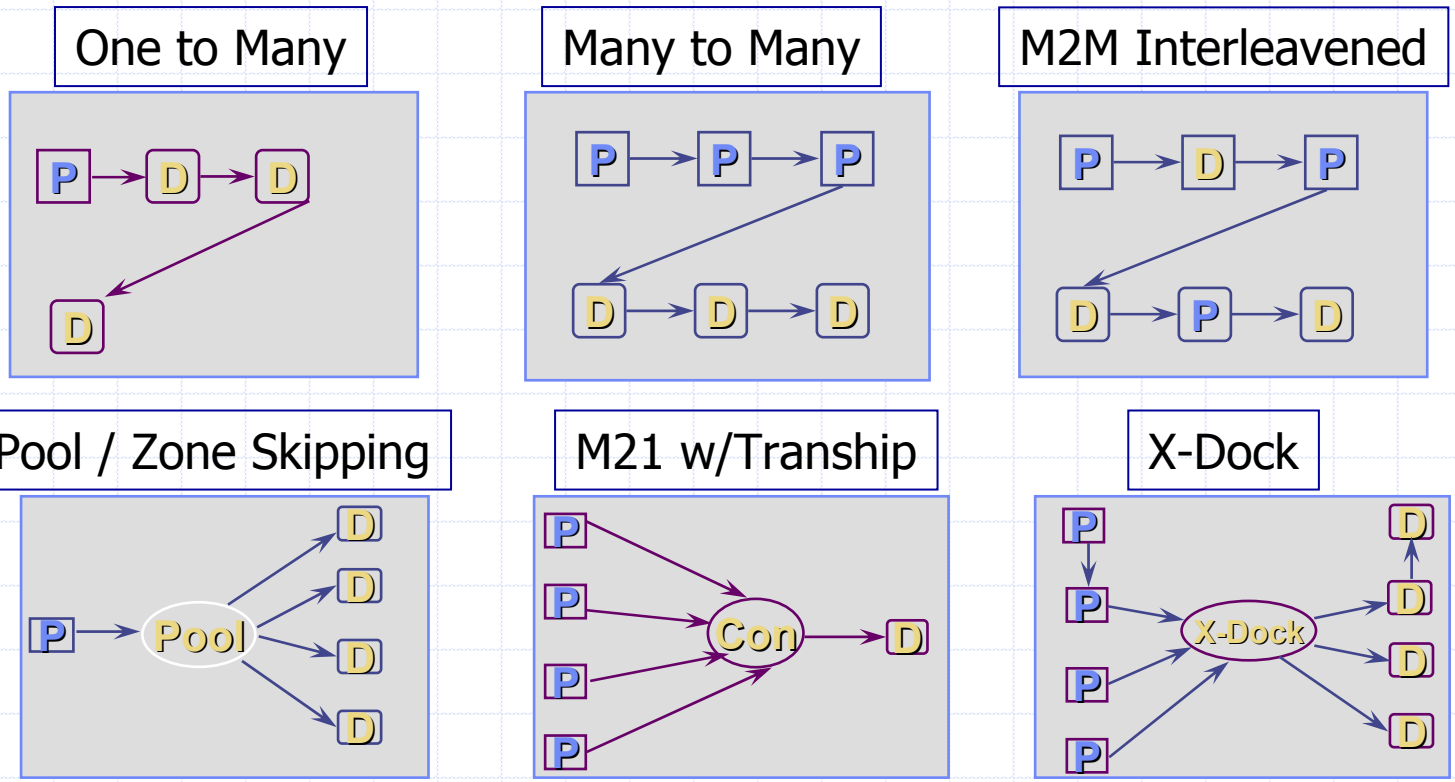


Decisions – Routing Options



- Strategic plan establishes the potential options that can be taken in execution

Network Consolidation Archtypes

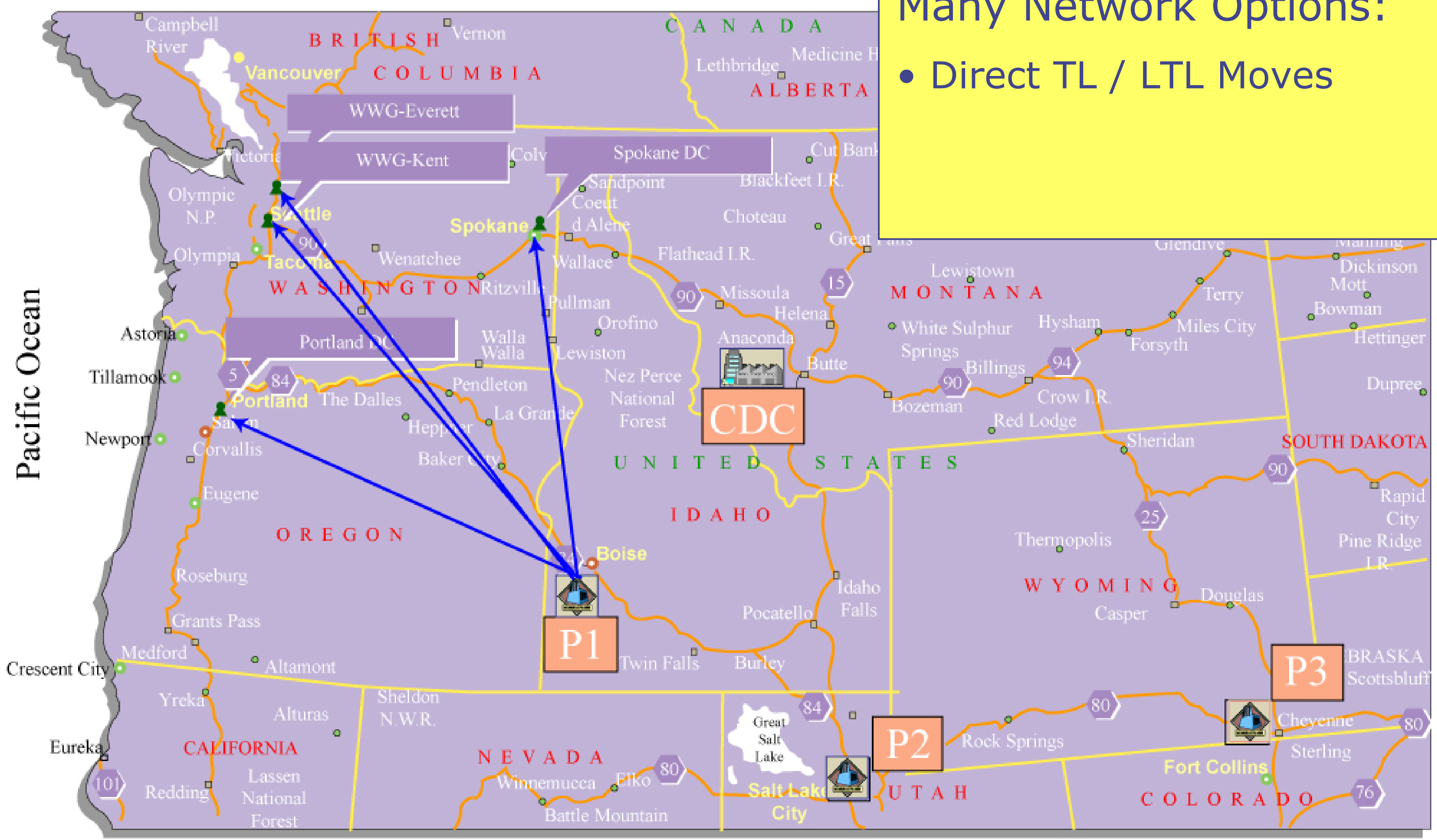


Manugistics

Transportation Routing Options

Example: New vendor has three plants that serve four distribution centers and may use the CDC in Butte.

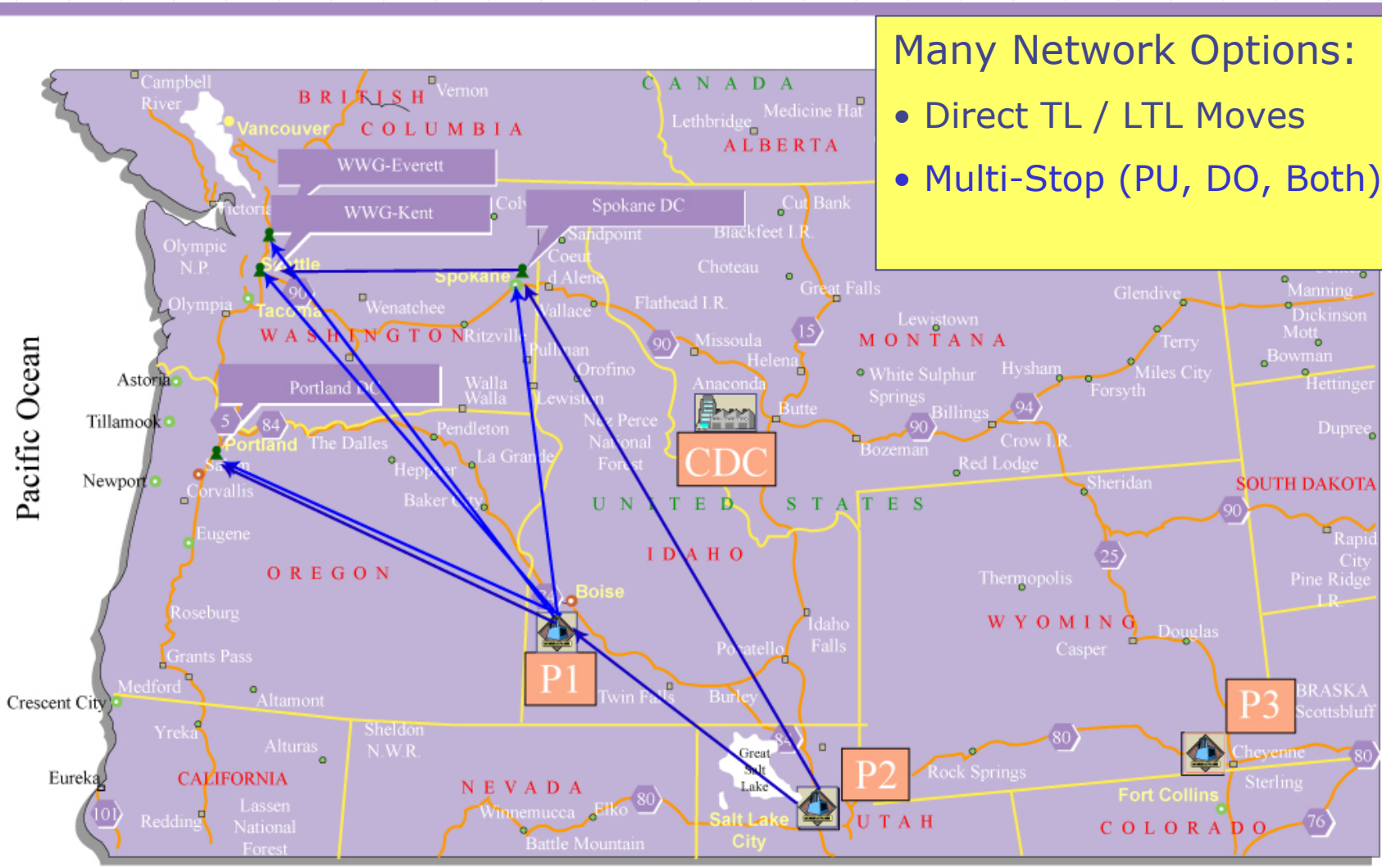
Transportation Routing Options



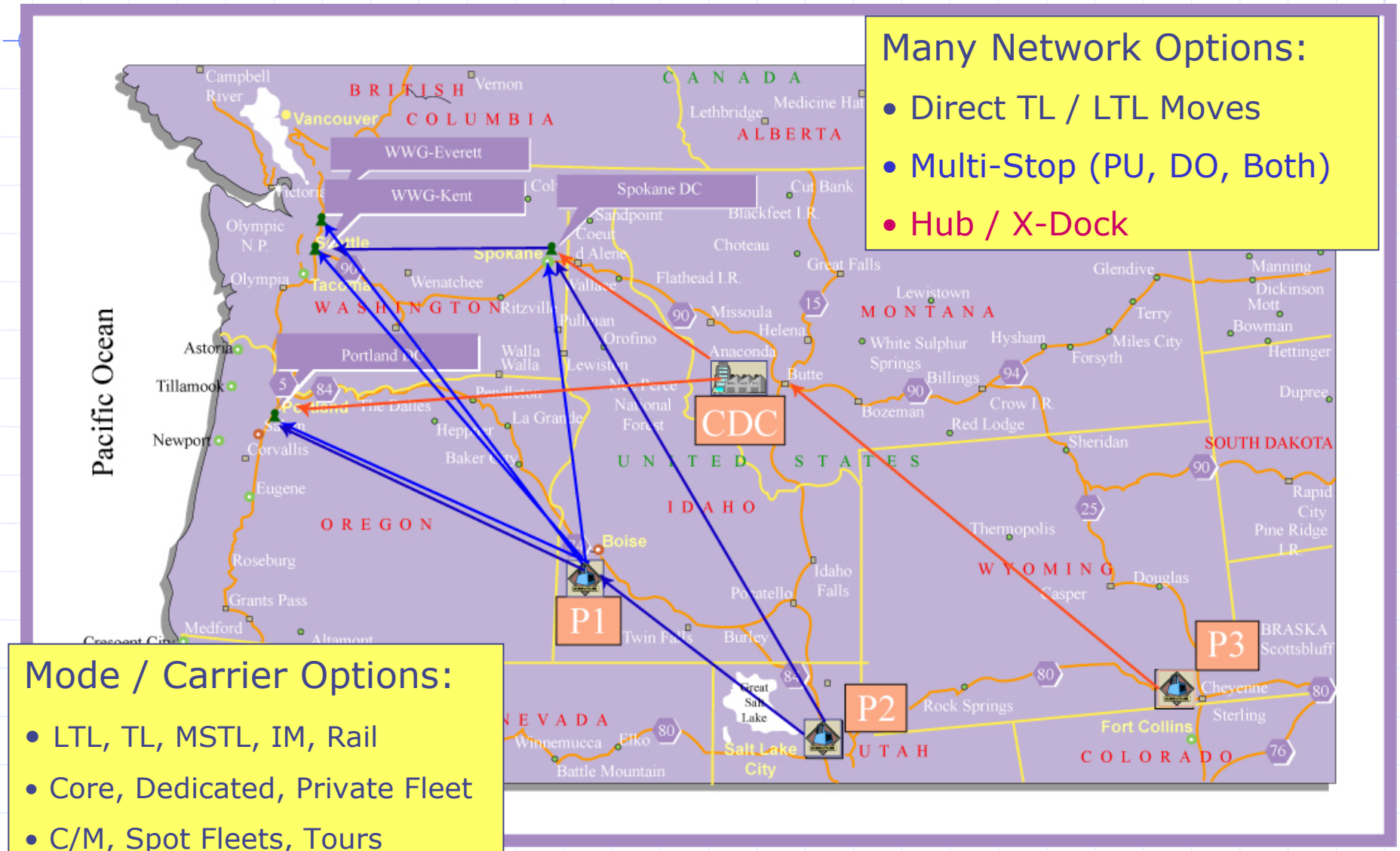
Many Network Options:

- Direct TL / LTL Moves

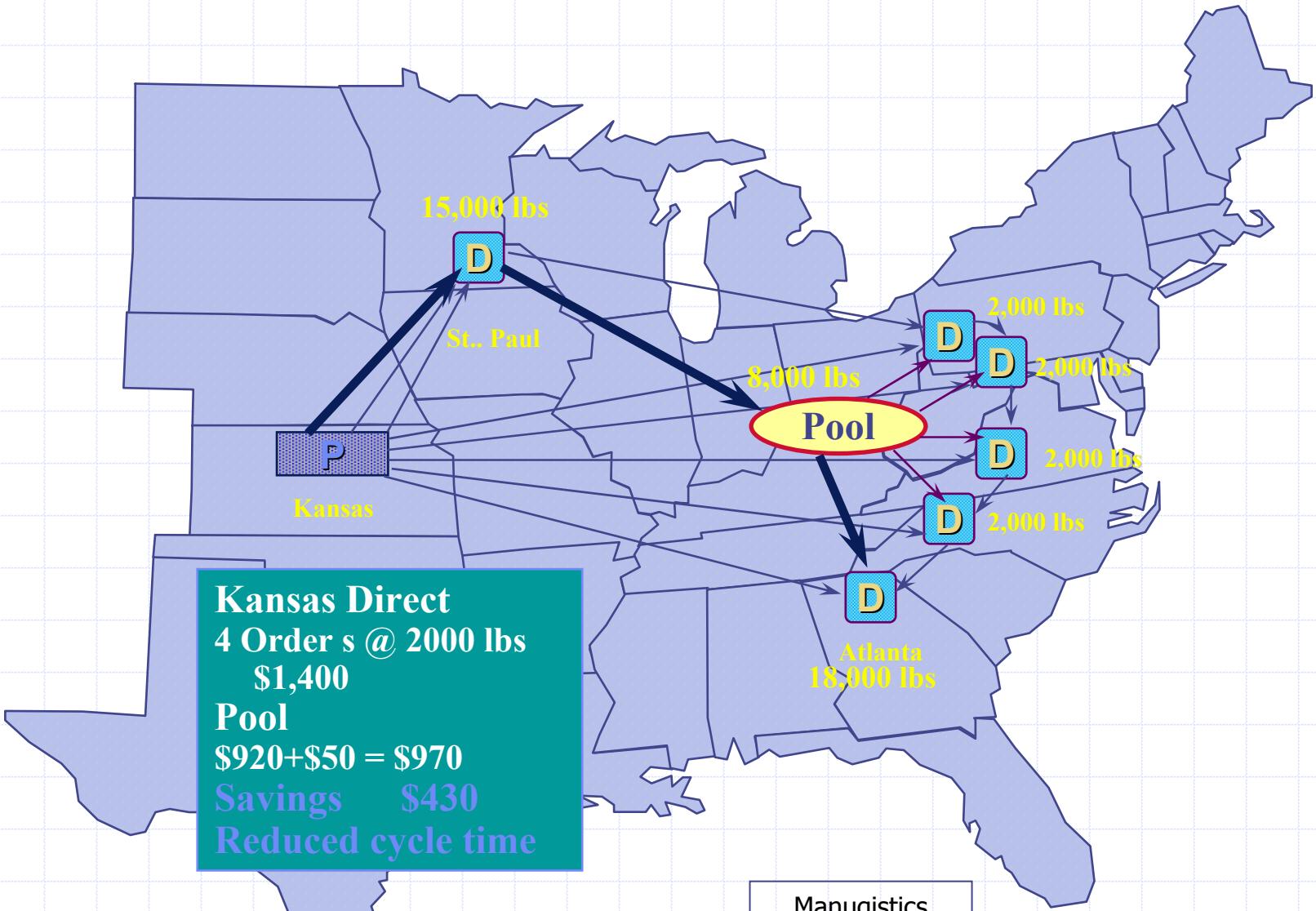
Transportation Routing Options



Transportation Routing Options



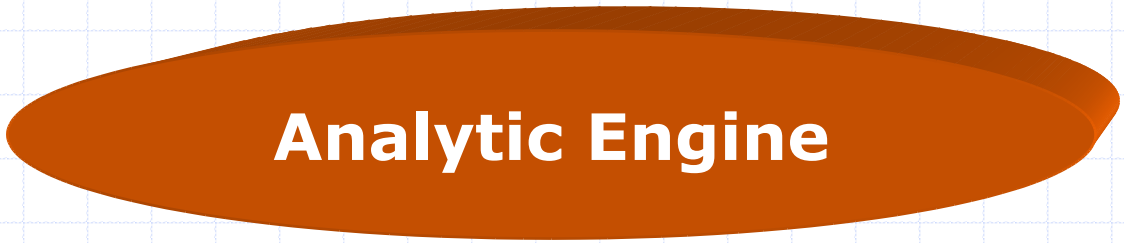
Transportation Network Strategies



Transportation Modeling

Inputs:

- **Demand forecast (transaction level data)**
- **Carrier tariffs, rates, capacities, & service levels**
- **Business constraints**
- **Equipment and facility profiles**
- **Potential routing / carrier options**

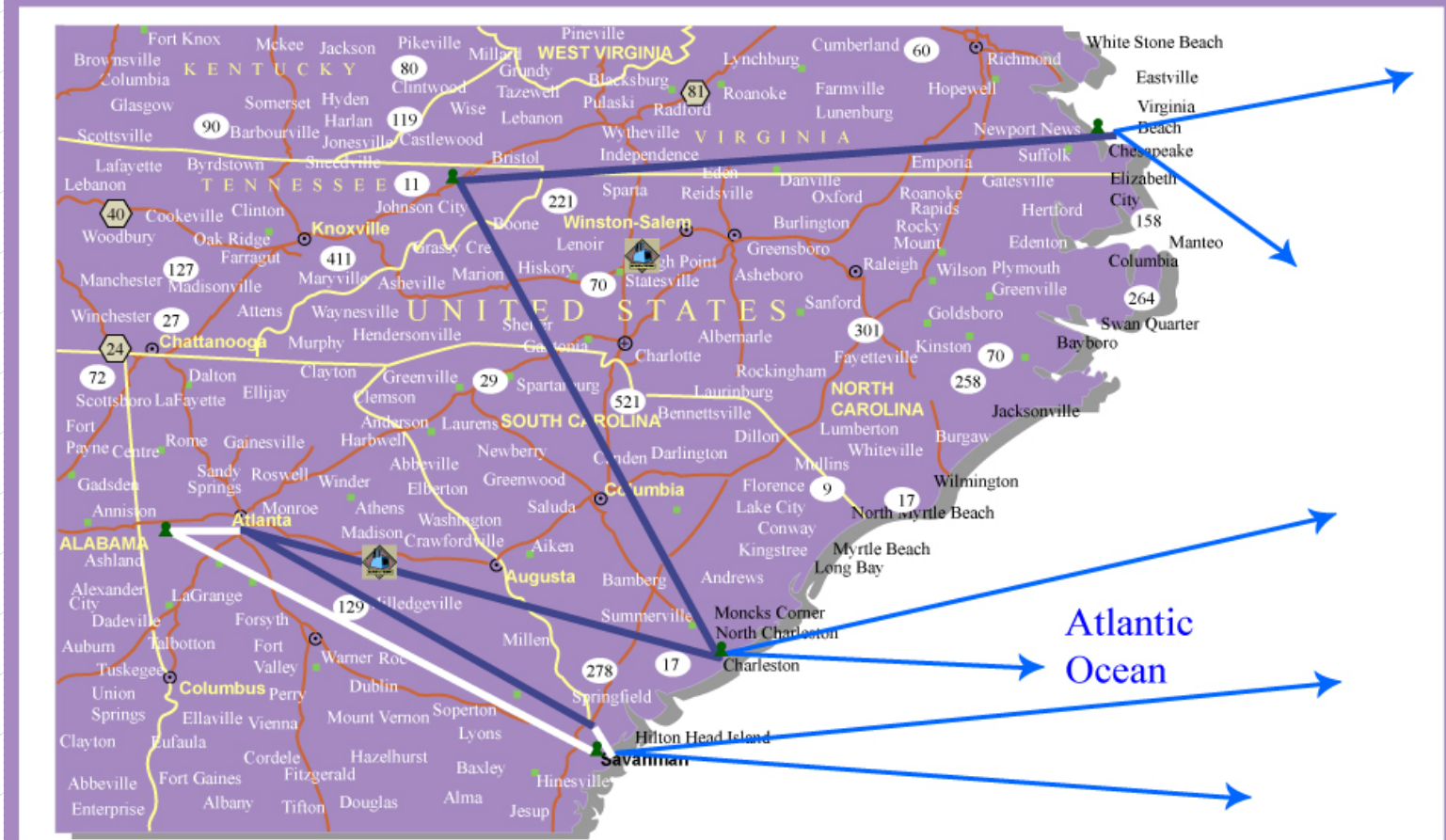


Outputs:

- **Total transportation costs**
- **Mode selection**
- **Fixed routing and itineraries**
- **Recommended sailings**

Transportation Modeling

Example: Two clients ship product to Rotterdam. There are rail and truck options to multiple ports with various ocean carrier options.



Transportation Modeling

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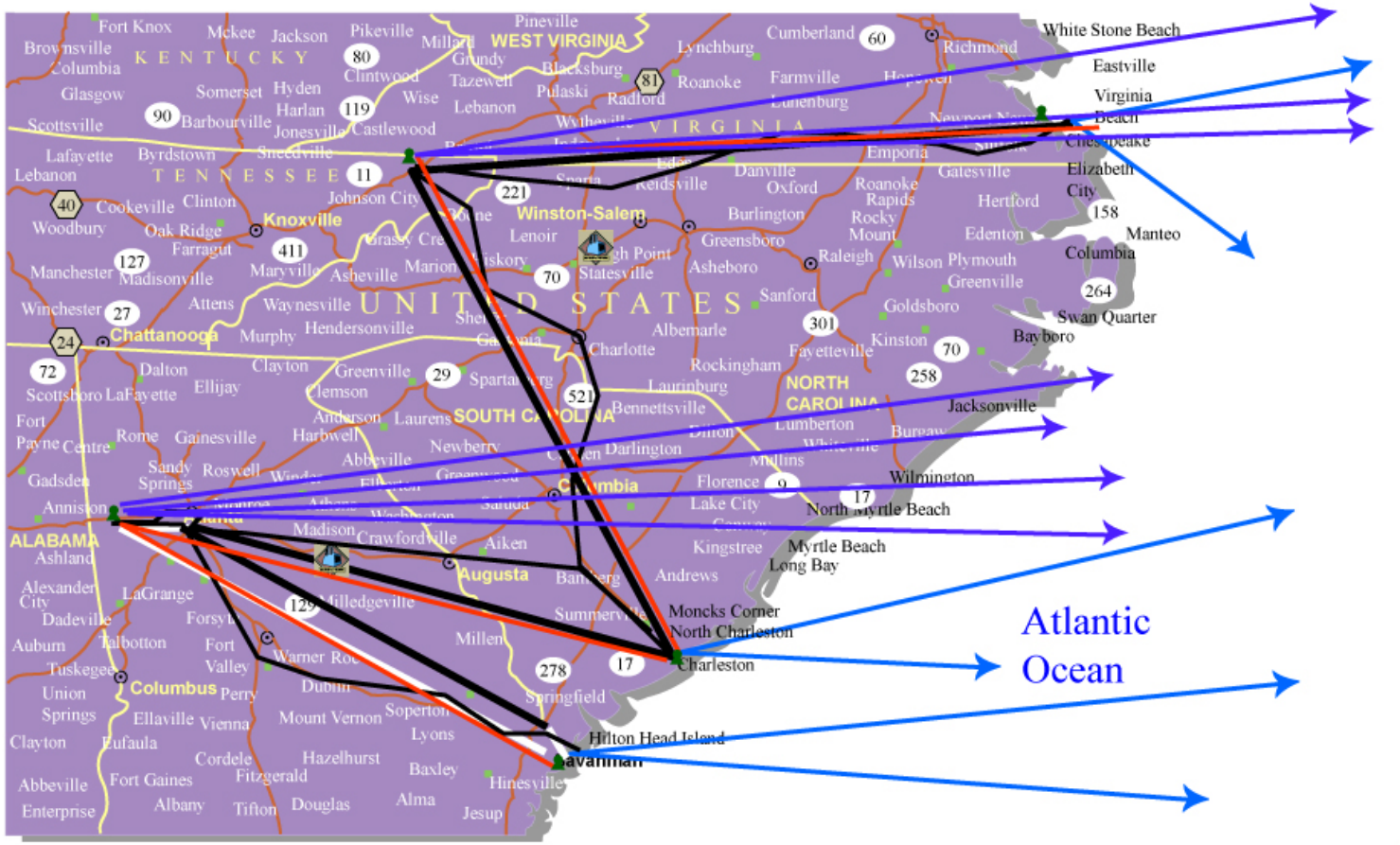
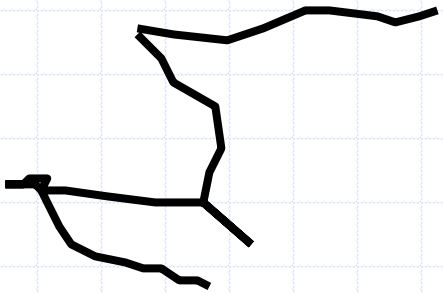
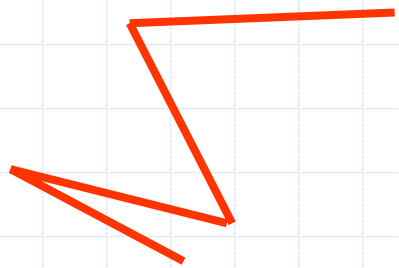


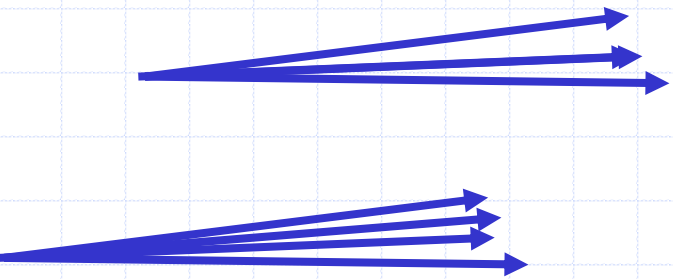
Three Layers of Networks



Physical Network: The actual path that the product takes from origin to destination. Basis for all costs and distance calculations – typically only found once.

Operational Network: The route the shipment takes in terms of decision points. Each arc is a specific mode with costs, distance, etc. Each node is a decision point.



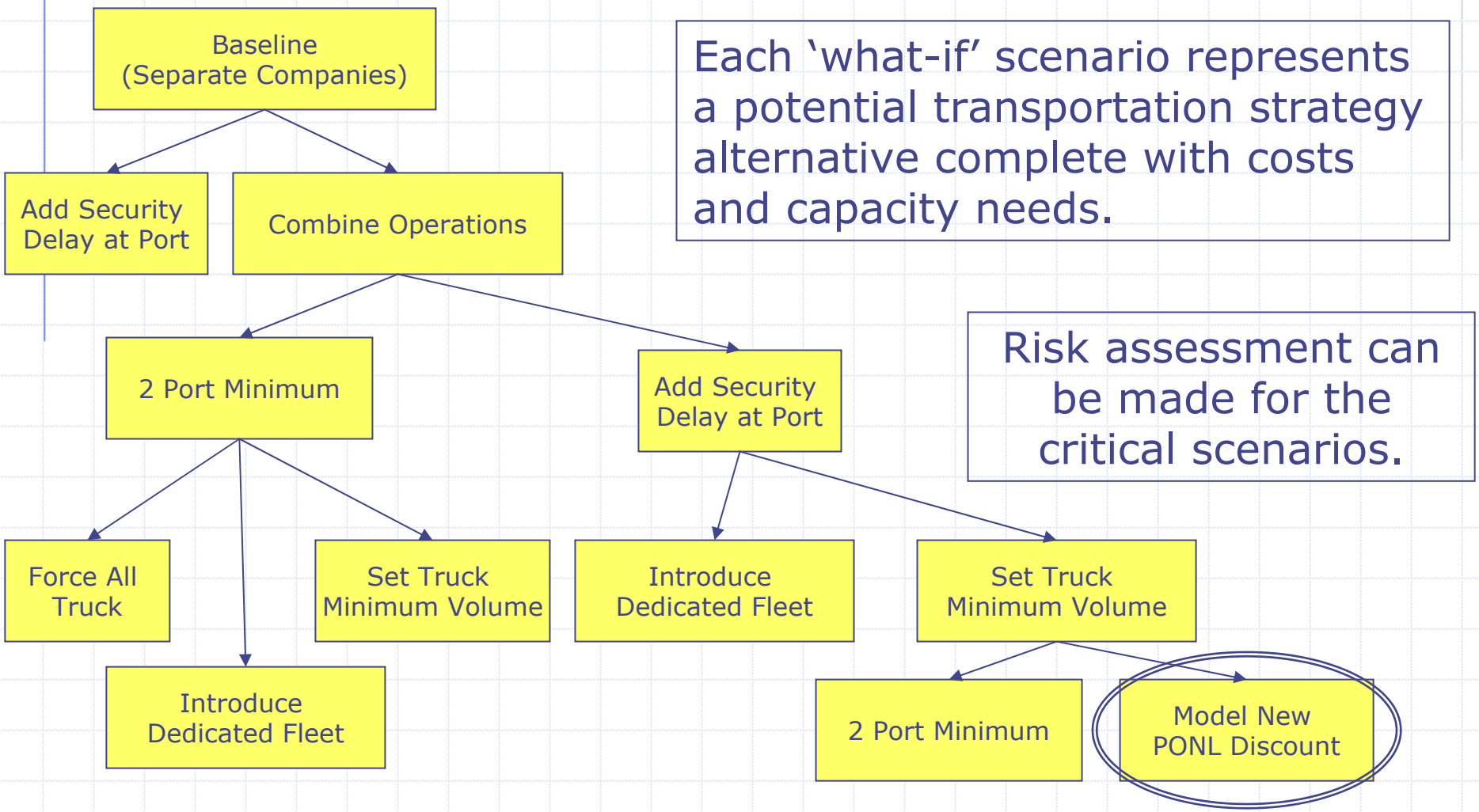


Service Network: A series of paths through the network from origin to destination. Each represents a complete option and has end to end cost, distance, and service characteristics.

Transportation Modeling

- Transportation Options
  - Carrollton ISO tanks can move via truck or rail to Charleston or Savannah
  - Kingsport ISO tanks can move via truck or rail to either Norfolk or Charleston
  - Each port has two sailing schedule options to Rotterdam
- Transportation Modes
  - Each mode is modeled with:
    - Variable & fixed costs
    - Service and capacity levels
    - Sailing schedules (day of week or fixed day)
- Potential Scenarios
  - Run each company separately (Baseline)
  - Run combined operations (leverage volume discount out of Charleston)
  - Introduce new security process at ports – impact of a one day delay
  - Relax delivery windows (measure potential cost reduction)
  - Force a 2 port solution (minimize risk of port closure)
  - Force an all bulk truck solution
  - Explore option of running a dedicated fleet for linehaul or drayage
  - Increase demand by 20% on certain lanes

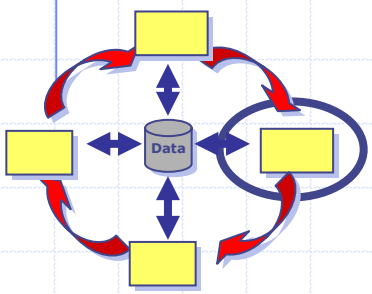
Transportation Modeling



Each 'what-if' scenario represents a potential transportation strategy alternative complete with costs and capacity needs.

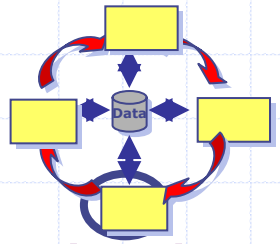
Risk assessment can be made for the critical scenarios.

Task: Procurement



- Multiple Levels of Procurement
  - Strategic
    - Looking at entire or large portions of network
    - Detailed analysis – value focused
    - Encourages use of sophisticated carrier proposals
    - Considers trade-offs between service and cost
  - Tactical
    - Collecting rates for some lanes from a few carriers
    - Minimal analysis – efficiency focused
    - No sophisticated proposals from carriers
  - Execution
    - Collecting spot rates for a specific load
    - Private / public exchanges
    - Considered component of execution system

Task: Execution



- Move products from initial origin to final destination is most cost effective manner while meeting service standards
- Most shippers use software systems (Transportation Management Systems)
- TMS works within strategic plan, procured carriers, and real-time information

PLAN: Create Shipments from Orders

EXECUTE: Select and tender to Carriers

MONITOR: Visibility of the status of Shipments

RECONCILE: Audit invoices and pay for Transportation

How Does a TMS Generate Value?

Visibility

- Improved communications efficiency with all trading partners
- Reduced levels of safety stock inventory.
- What is the current status of your PO's/orders/shipments?

Automation

- Reduces resources, cost, and time to accomplish activities
- Allows user to manage the exceptions
- Minimizes maverick/rogue behavior and human error

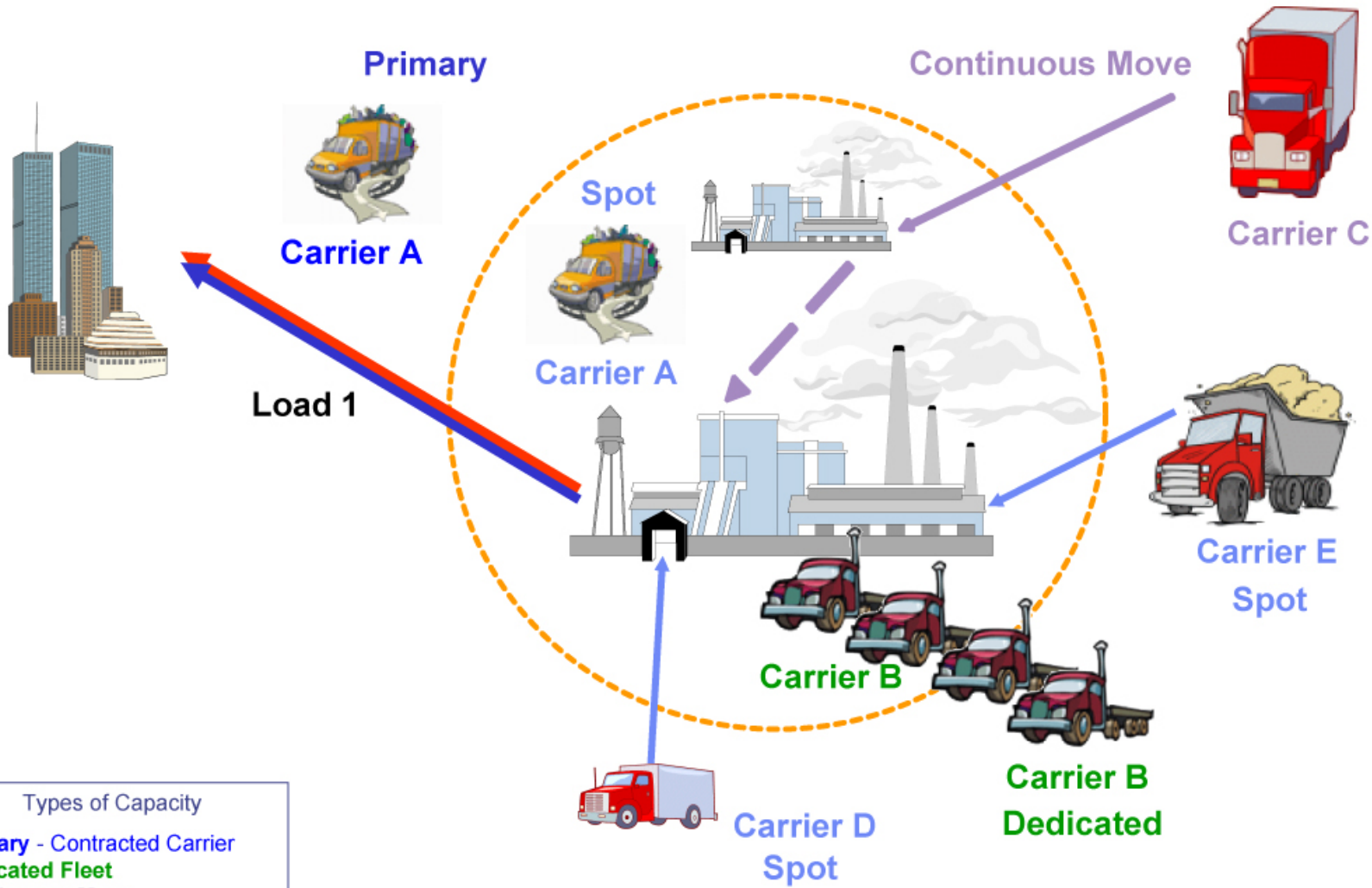
Decision Support

- Provides dramatic cost reductions and efficiency gains
- Make the 'business optimal' decision at every stage of the process
- Assist logistics professionals in making decisions

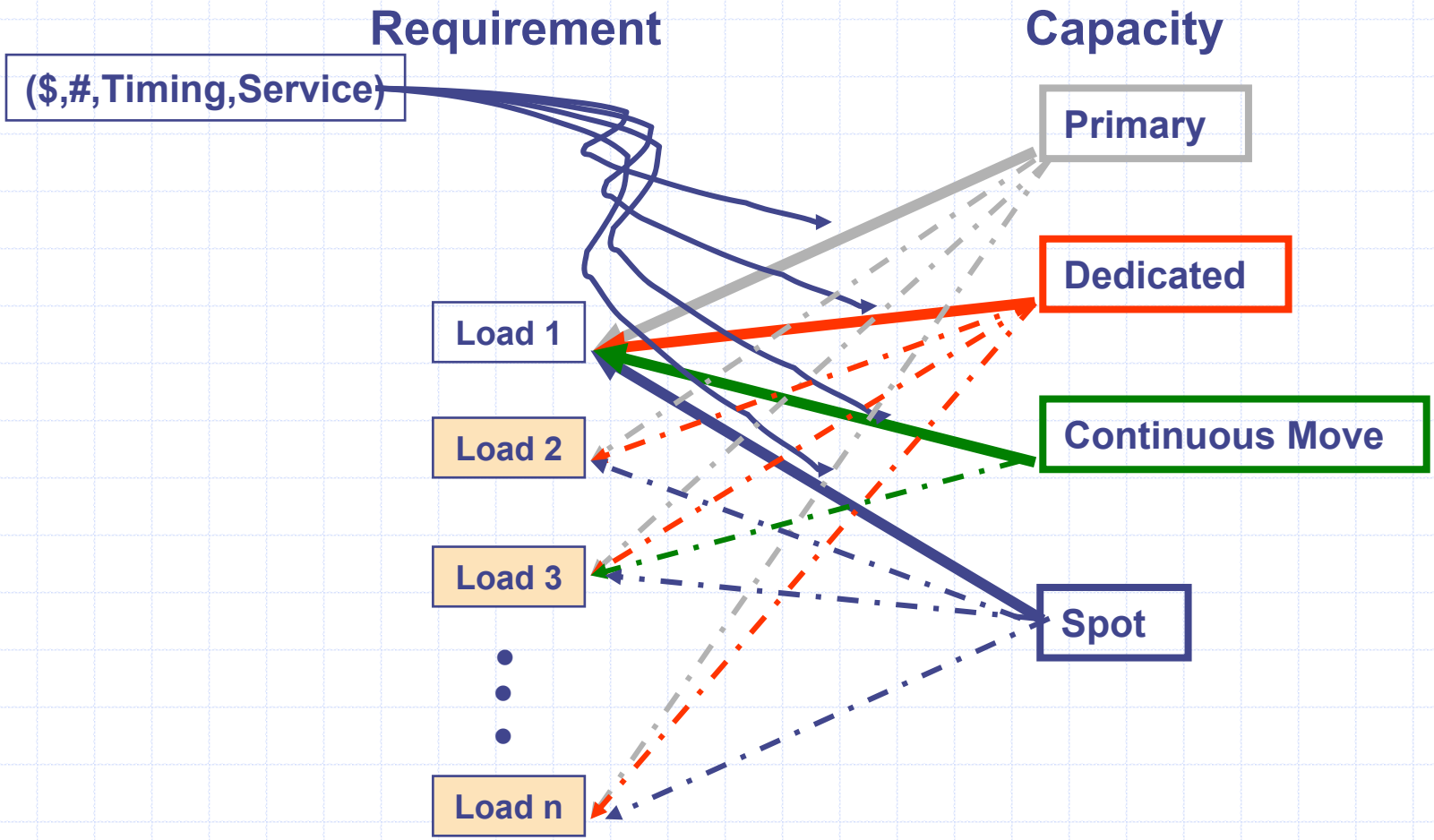
Execution Considerations

- Considerations
  - How do orders drop? Batched vs Continuous?
  - How much time is allowed between drop and must-ship? Weeks? Days? Hours? Minutes?
  - What percentage of orders change after release?
  - How do they change? Quantity? Mix? Destinations? Timing?
  - What is the length of haul?
  - How many orders are "in play" at any time?
- Key Decision Support Decisions
  - Carrier Selection
    - Routing and Rating
    - Routing Guide Compliance
    - Continuous Moves
  - Consolidation & Routing
    - Postponement of shipments in time
    - Vehicle consolidation (LTL to TL, Parcel to LTL)

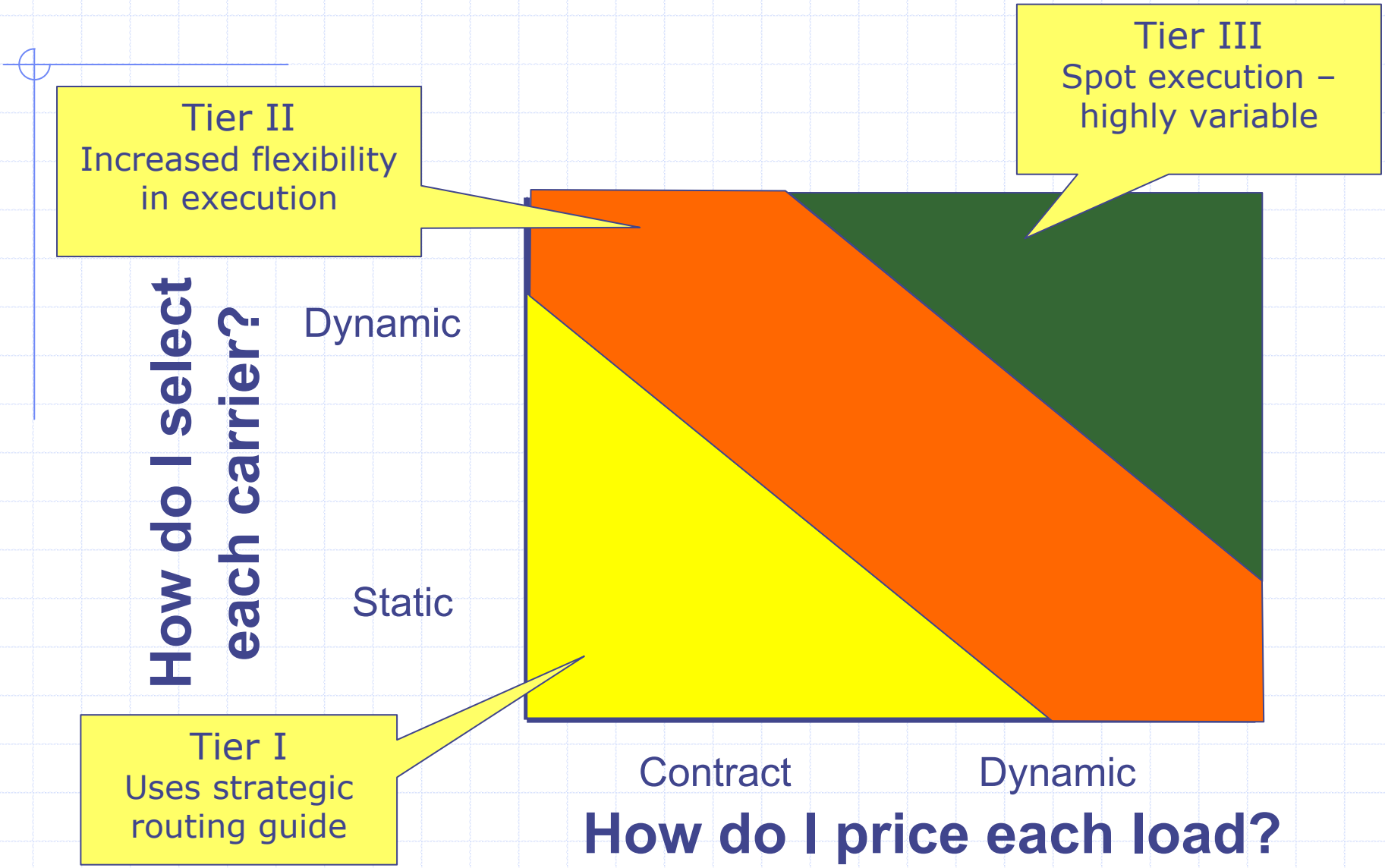
Carrier Selection



Carrier Selection

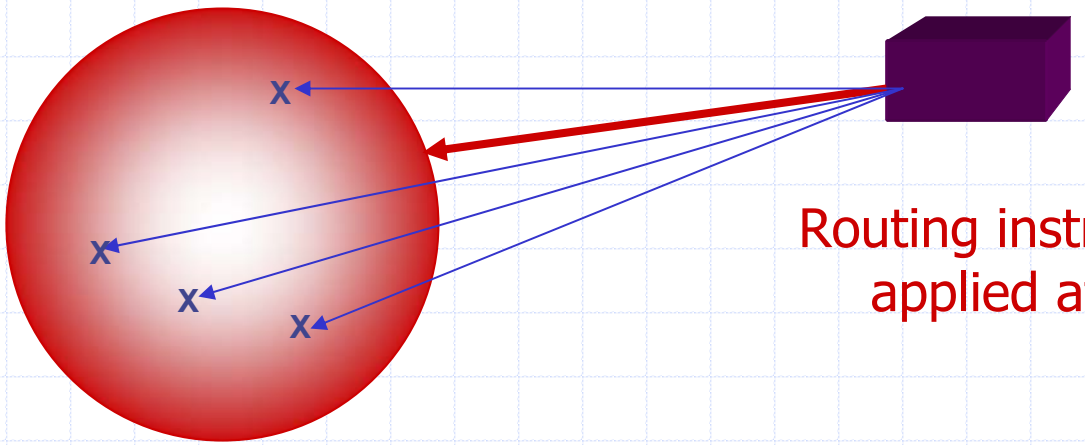


Approaches Must Be Linked



Note on Rating vs Routing

- Separation of Rating Engine and Routing Guide
  - Older systems do not make this distinction
  - Carrier selection (routing guide) hardwired into rating engine
  - Limits the flexibility and potential new carrier options

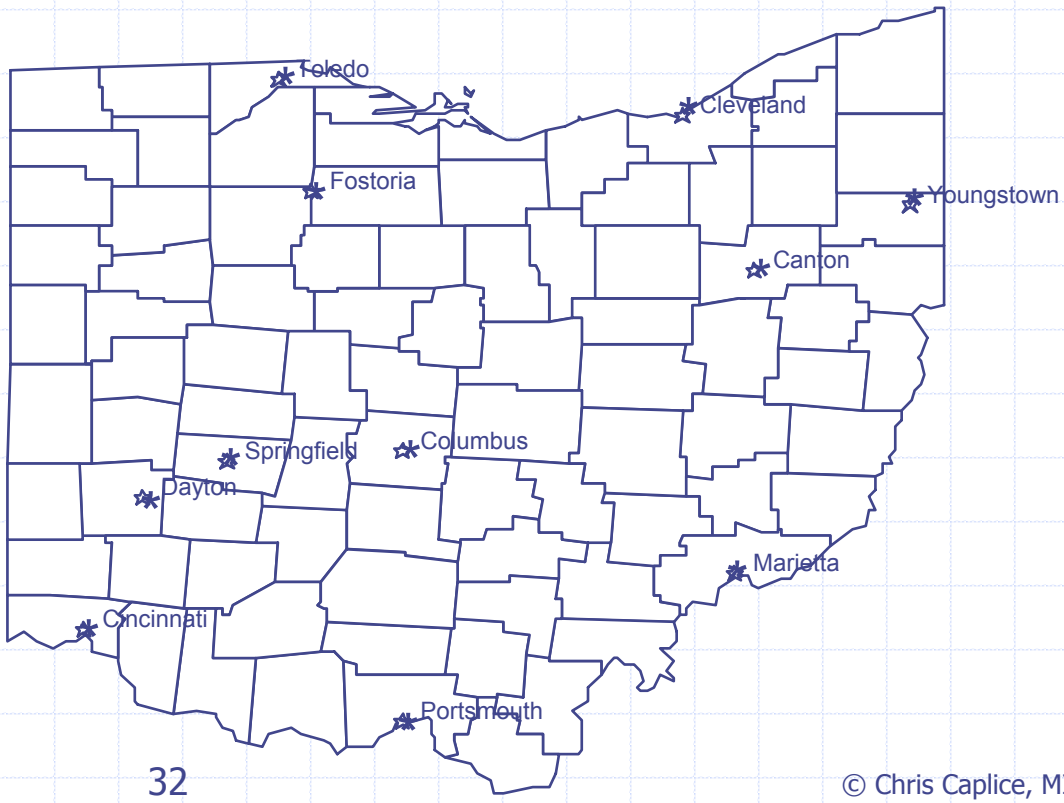


Routing instructions can be applied at an aggregated level

Rates can be applied to individual fine grained OD pairs

Consolidation & Routing

- Find lowest cost routing of orders through consolidation in time, on vehicle, or through facilities.
- Most TMS software contains consolidation or optimization modules



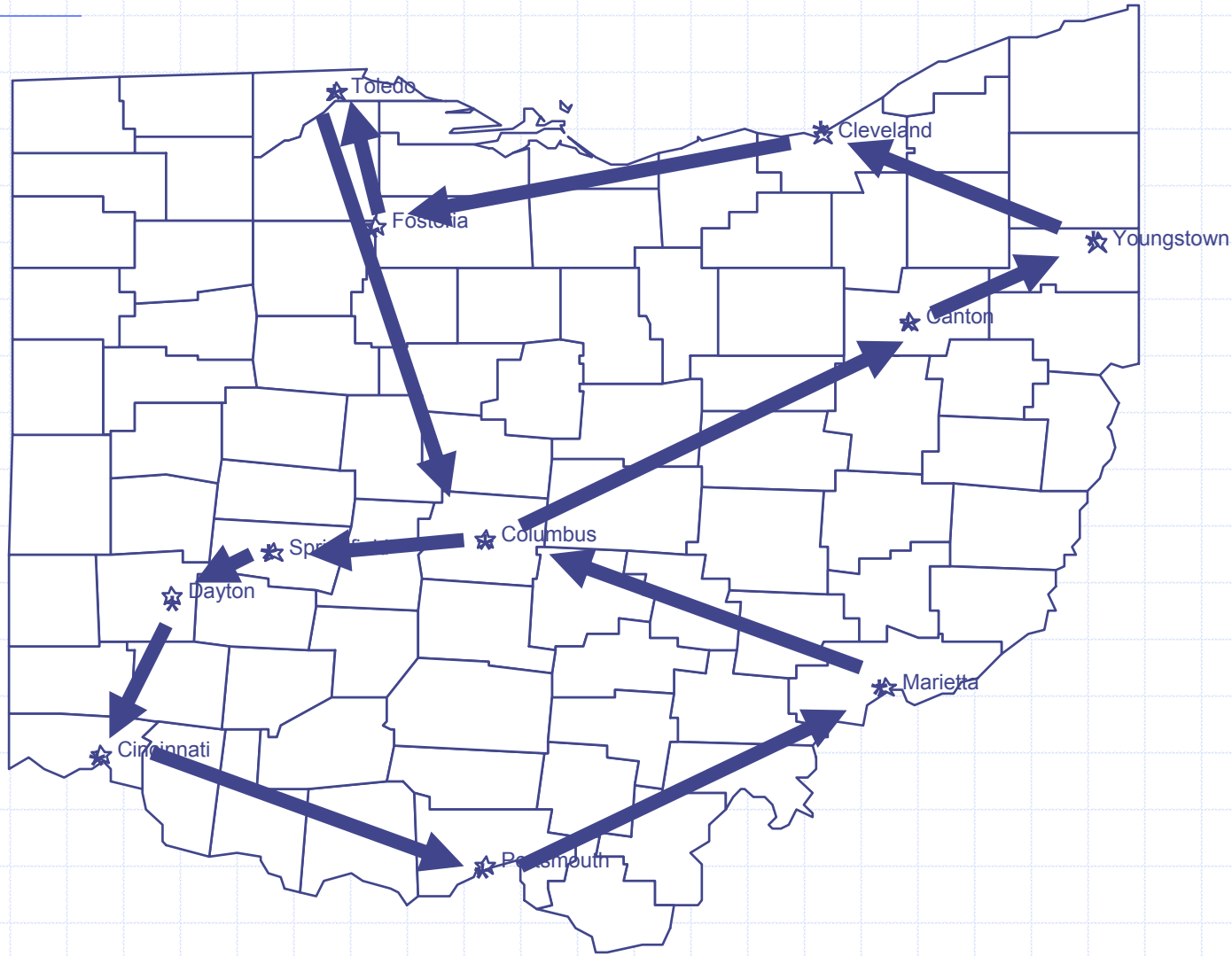
Multiple Vehicle Scheduling Algorithm

MILP, Set Covering, Column Generation

	Route 1	Route 2	Route 3	….	…..	Route M	
	C1	C2	C3	….	….	Cm	
Stop A	1	0	0	1	0	1	1
Stop B	1	1	0	0	1	0	1
Stop C	1	1	1	1	0	0	1
Stop D	0	1	1	0	1	1	1
Stop E	0	0	1	1	0	0	1
Stop F	0	0	0	0	1	0	1
Stop G	0	0	0	0	0	1	1
…	0	0	0	0	0	0	1
..	0	0	0	0	0	0	1
Stop N	0	0	0	0	0	0	1

- Each Row represents one of the N stops
- Each Column represents a generated vehicle route and its cost
- Each matrix coefficient, a_{ij}, is {0,1}, identifying the stops on the j'th route
- Define Z_{ij}, {0,1}, "1" if Stop "i" is on Route "j" , else "0"
- Define Y_j, {0,1}, "1" if the sum of Z_{ij} >0 , i=1,n ; else "0"
- Minimize: the sum of $C_j Y_j$, , j=1,m
- Subject to: the sum of a_{ij} Z_{ij} =1, j=1,m; for all i

Optimal Routing Solution

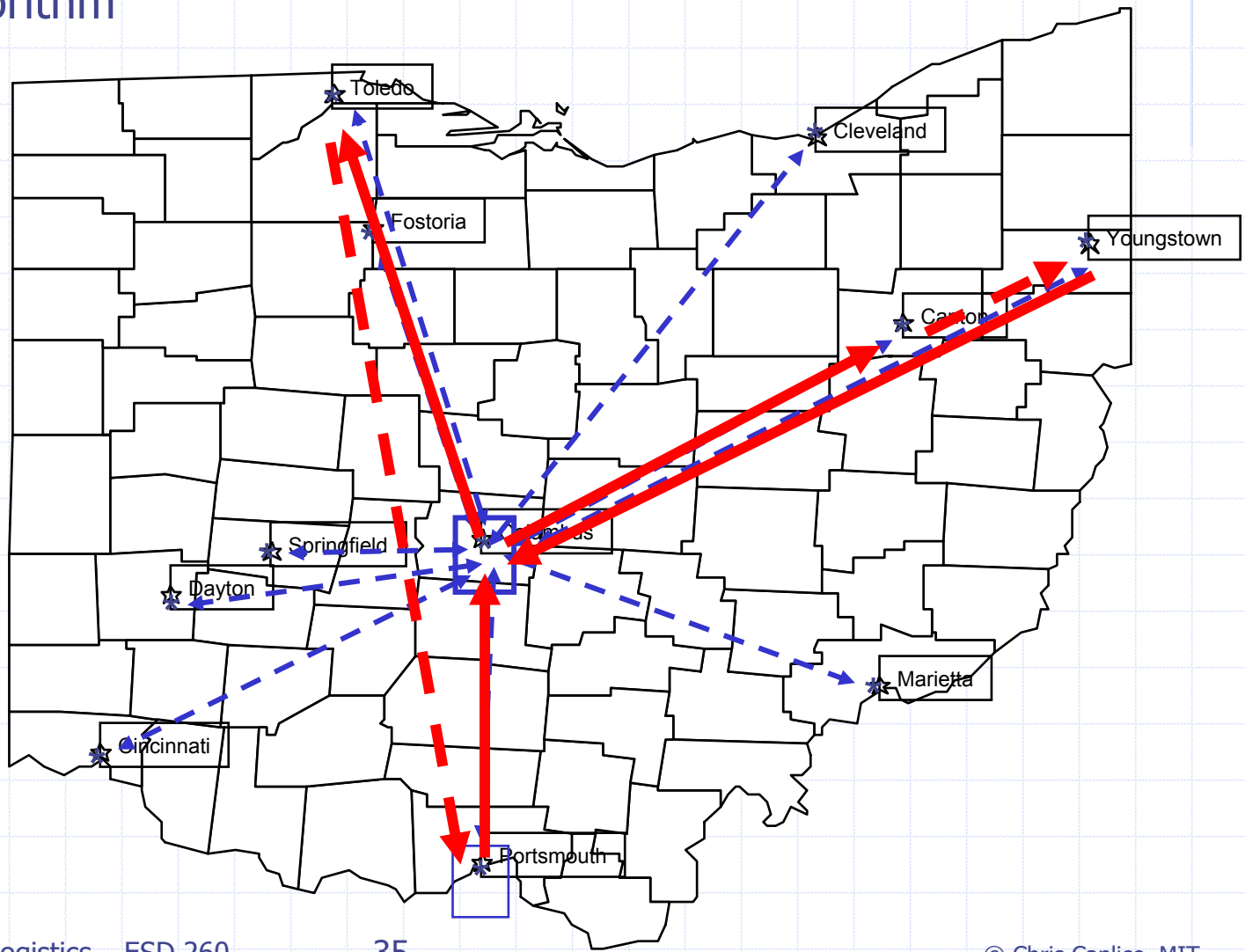


Heuristic Approach – Savings

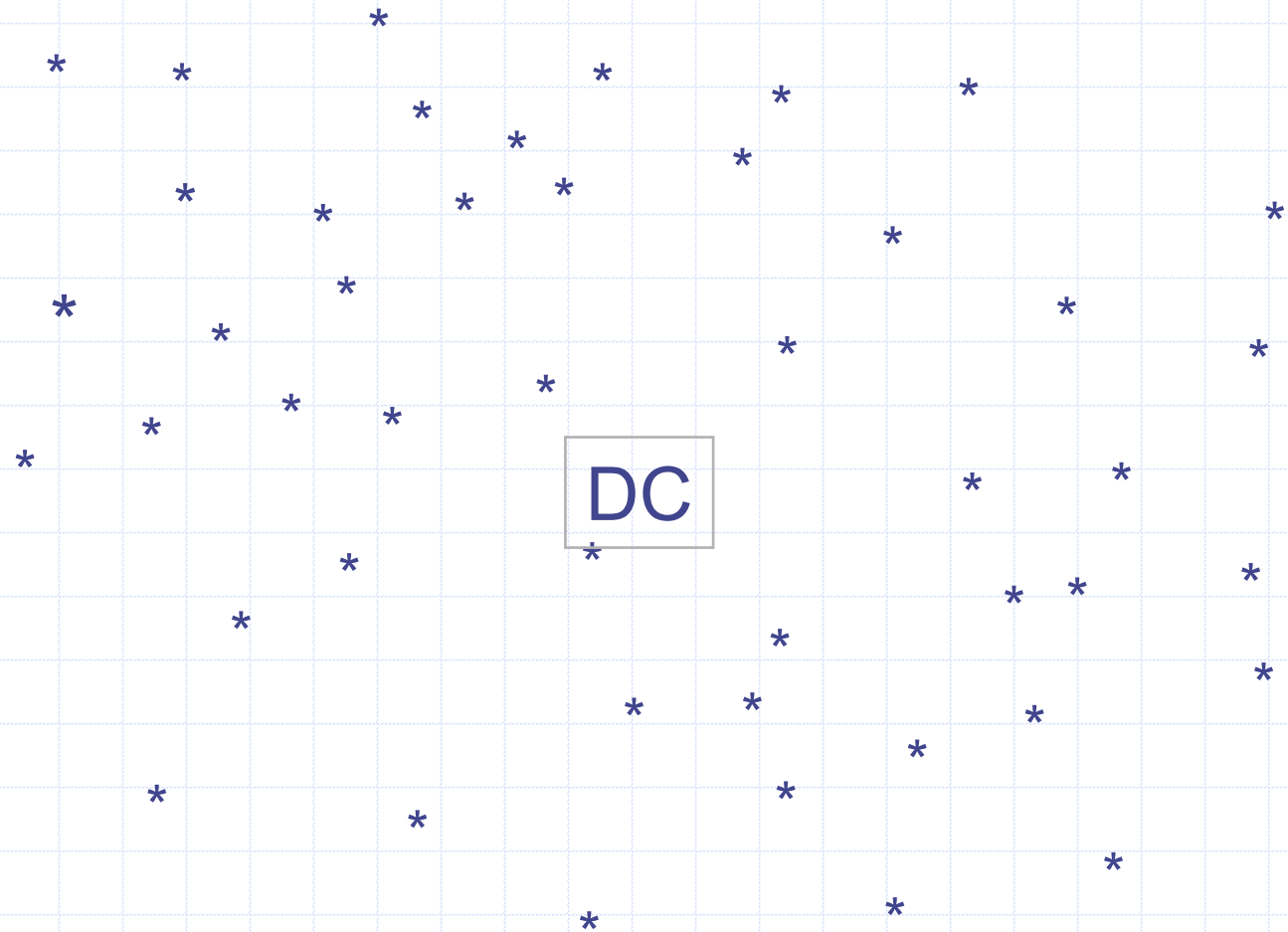
Clarke-Wright Algorithm

1. Serve each stop with direct out and back
2. Find savings for each pair

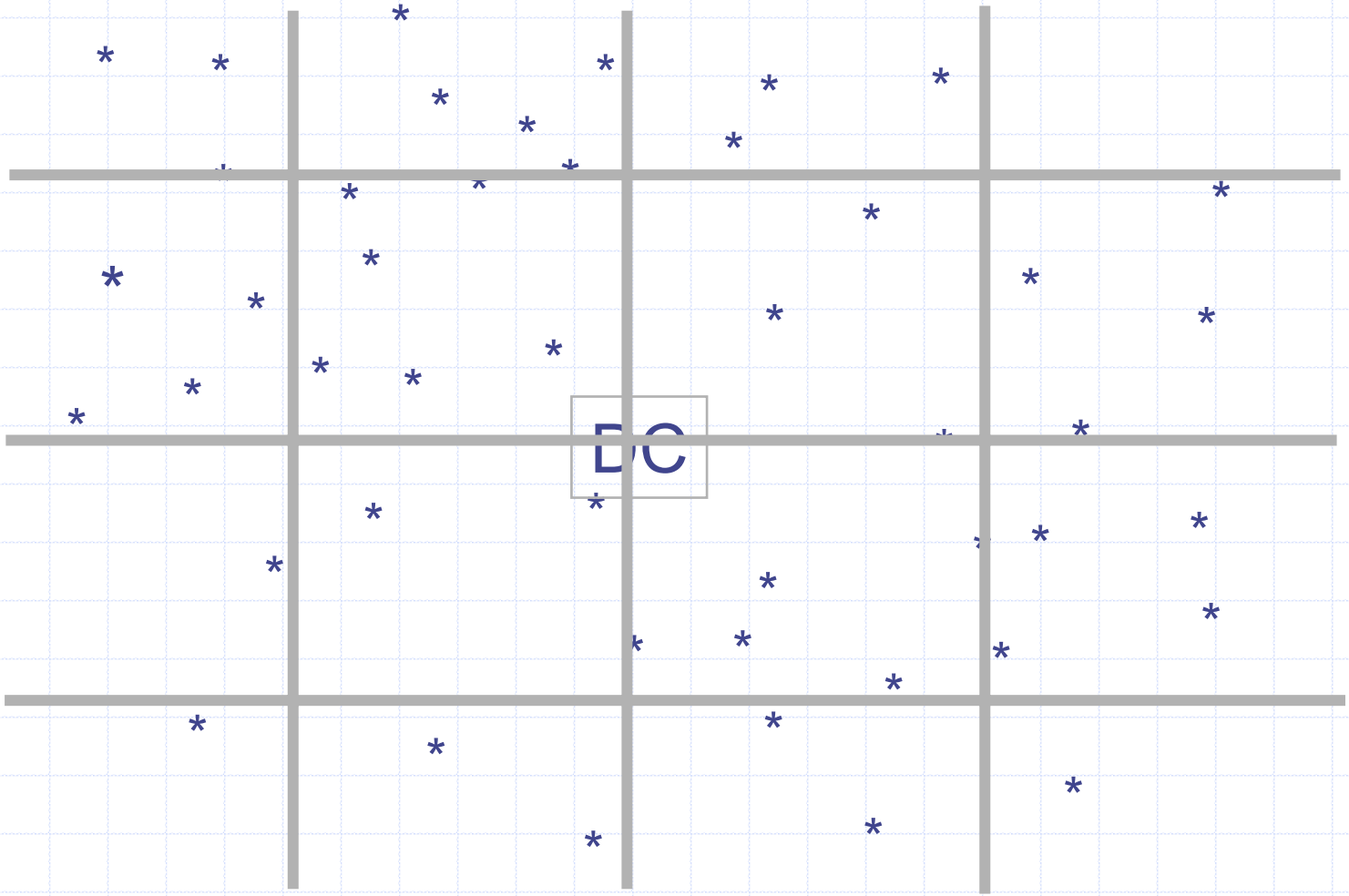
   $S=D_{OA}+D_{OB}-D_{AB}$
3. Combine loads that increase savings and $<V_{MAX}$



Heuristic Approach – Cluster & Sweep



Heuristic Approach – Cluster & Sweep



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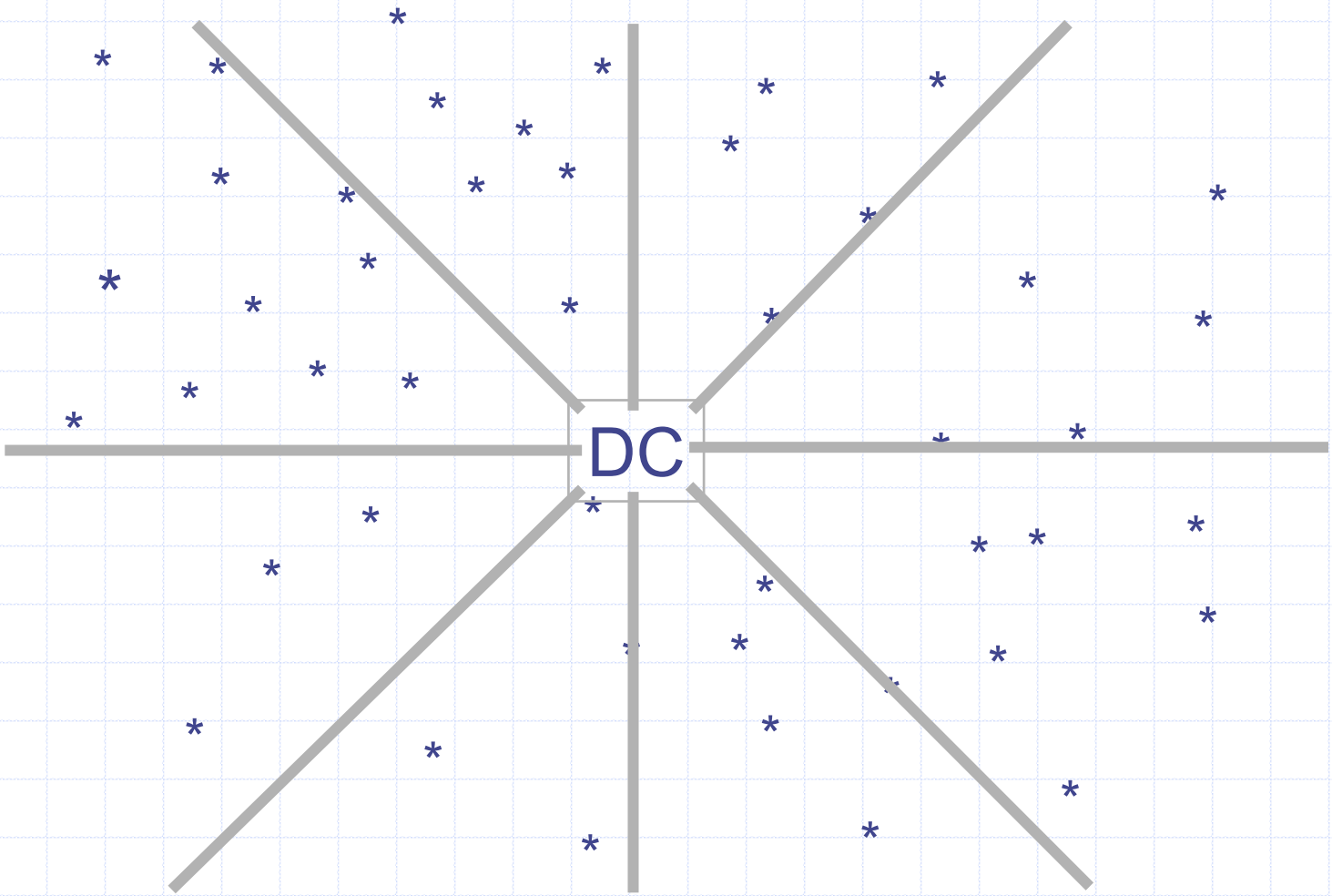

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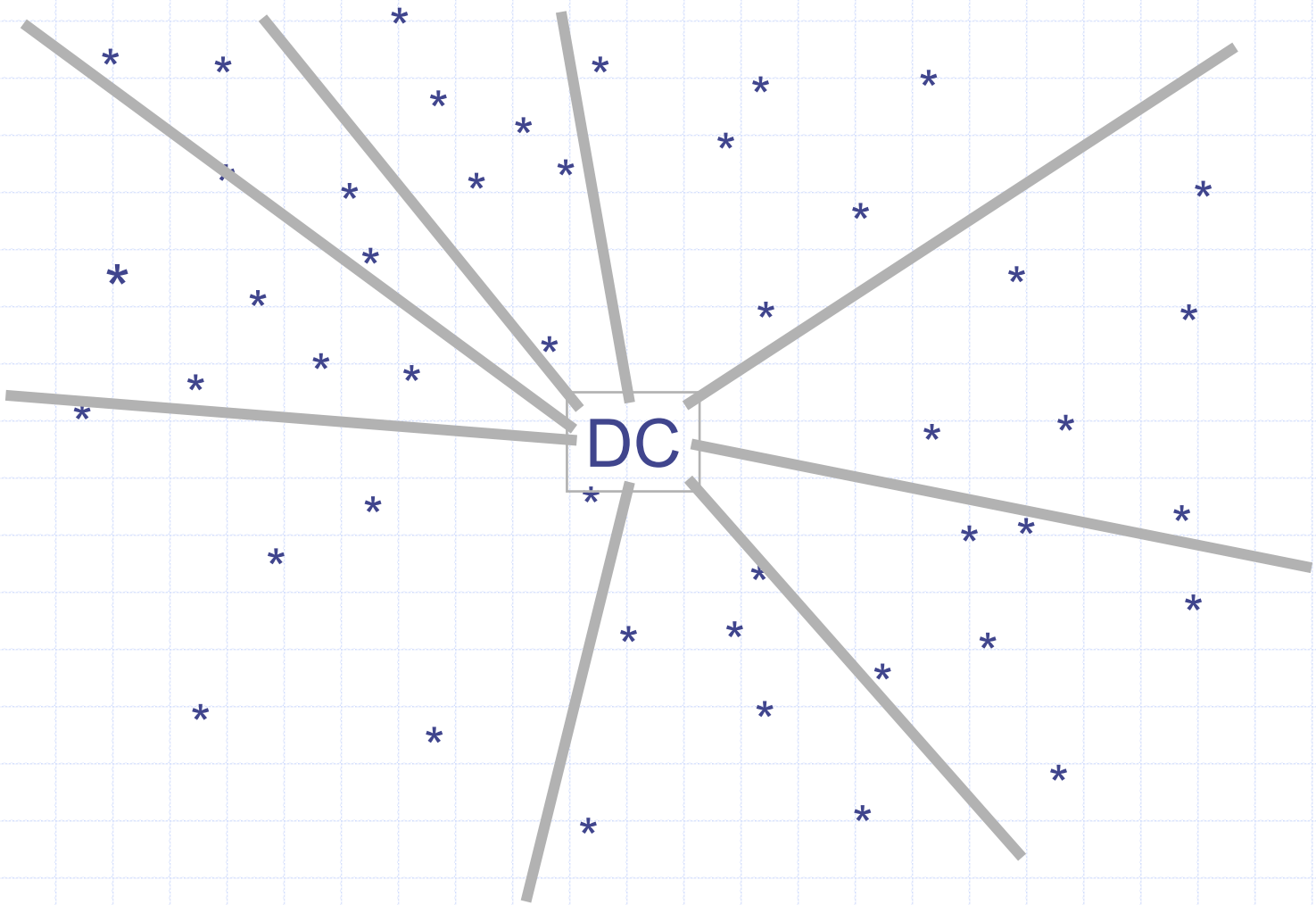
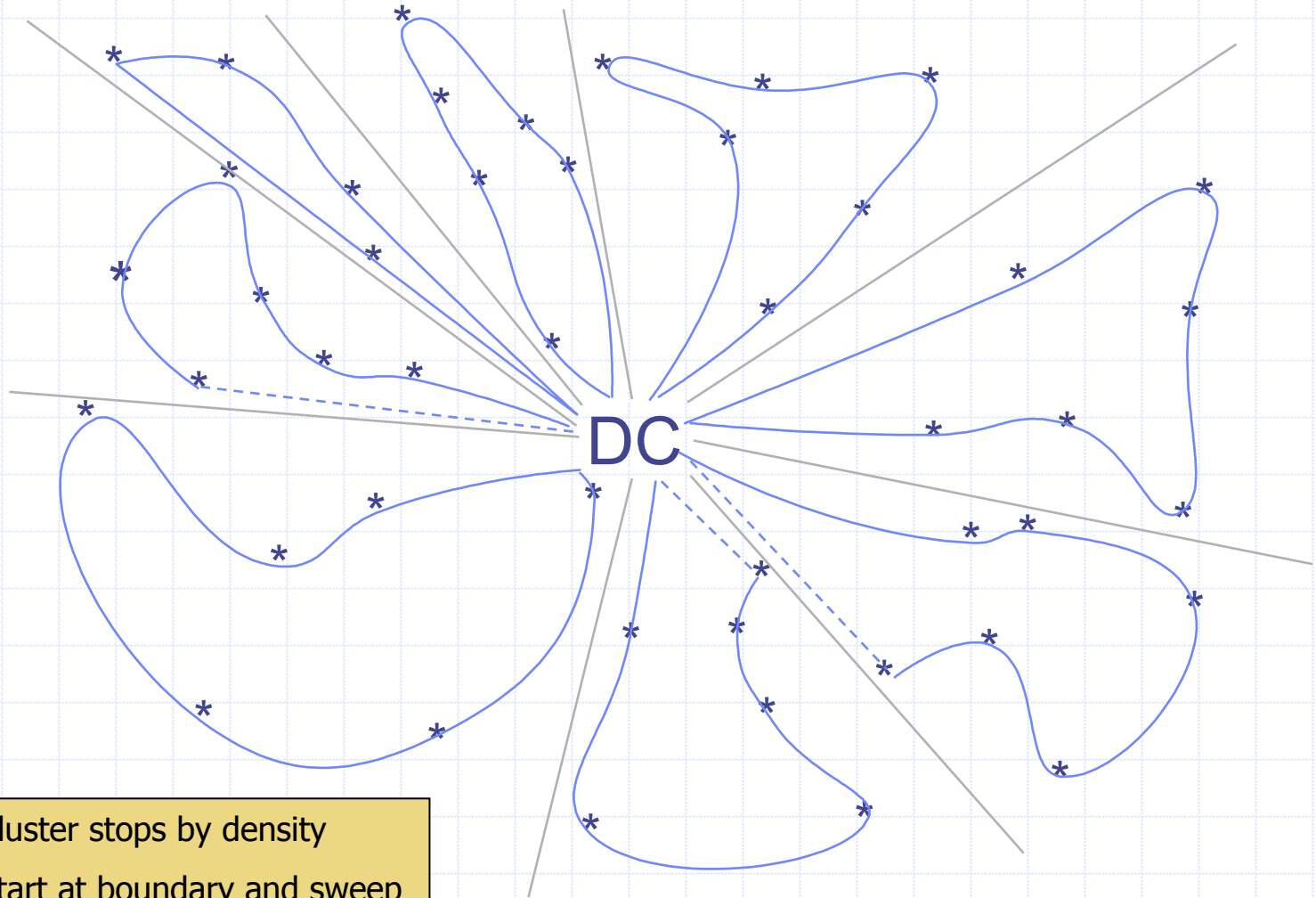


Heuristic Approach – Cluster & Sweep



1. Cluster stops by density
2. Start at boundary and sweep CW adding stops until $=V_{MAX}$

Regardless of Approach

- Rules of Thumb
  - Good routes are "rounded", not "star shaped"
  - Good routes don't cross themselves or others
  - Good sectors are "pie shaped", not "checker board"
  - Good solutions "look like a daisy"
- Good Practice Tips
  - Always use a Preview-Analyze-Review methodology
  - Periodically visit the internal logic within the TMS
  - Never discount the salty expert who has been doing this longer than you've been alive
  - Identify all special conditions (customer A must be delivered to first) and then validate or reject them

Questions