Inventory Management

Distribution Requirements Planning

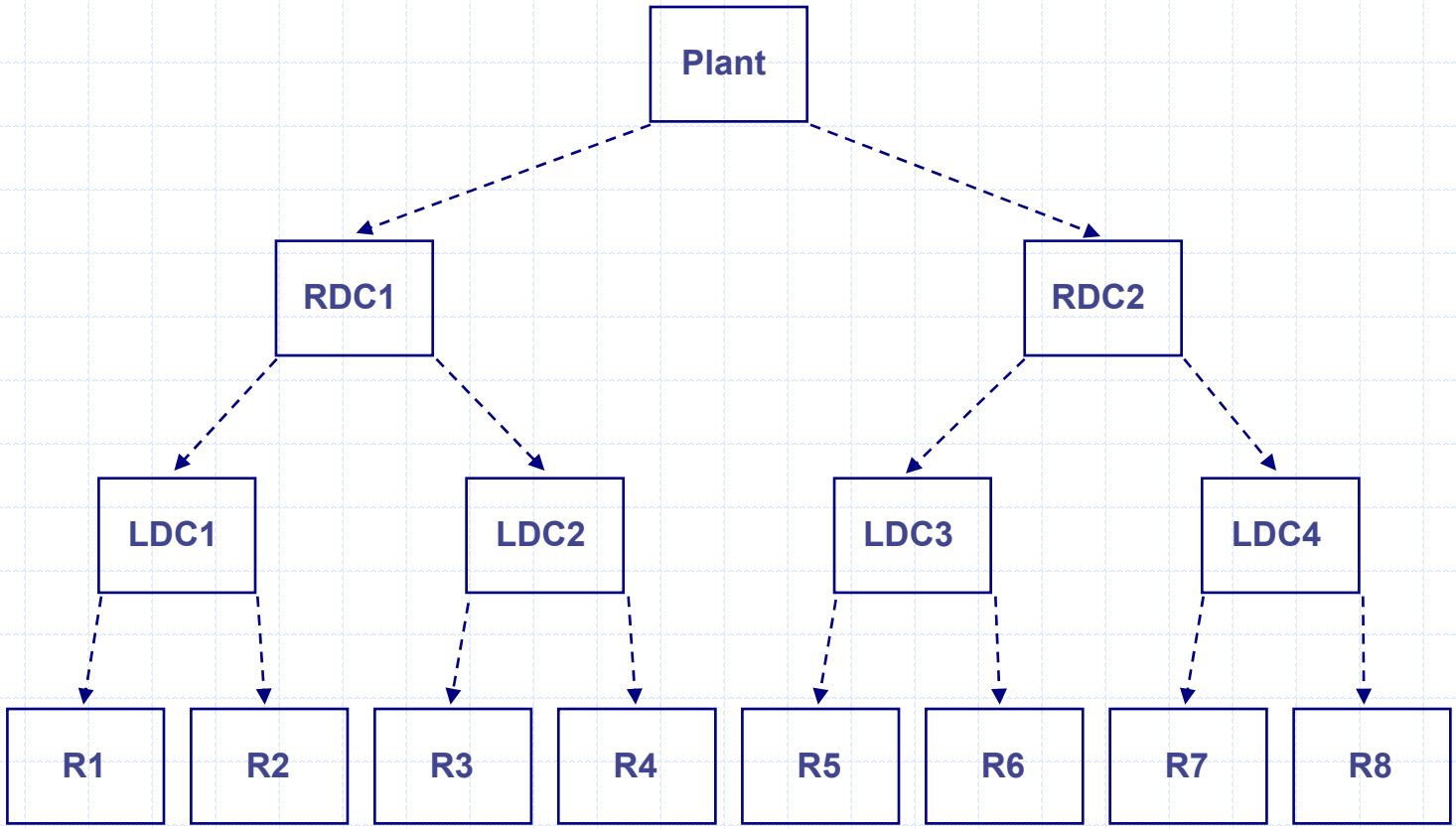
Lecture 11
ESD.260 Fall 2003

Caplice

Assumptions: Basic DRP Model

- Demand
  - Constant vs **Variable**
  - **Known** vs Random
  - Continuous vs **Discrete**
- Lead time
  - Instantaneous
  - **Constant** or **Variable** (deterministic/stochastic)
- Dependence of items
  - **Independent**
  - Correlated
  - Indentured
- Review Time
  - **Continuous** vs Periodic
- Number of Echelons
  - One vs **Many**
- Capacity / Resources
  - **Unlimited** vs Limited
- Discounts
  - **None**
  - All Units or Incremental
- Excess Demand
  - **None**
  - All orders are backordered
  - Lost orders
  - Substitution
- Perishability
  - **None**
  - Uniform with time
- Planning Horizon
  - Single Period
  - **Finite Period**
  - Infinite
- Number of Items
  - **One**
  - Many

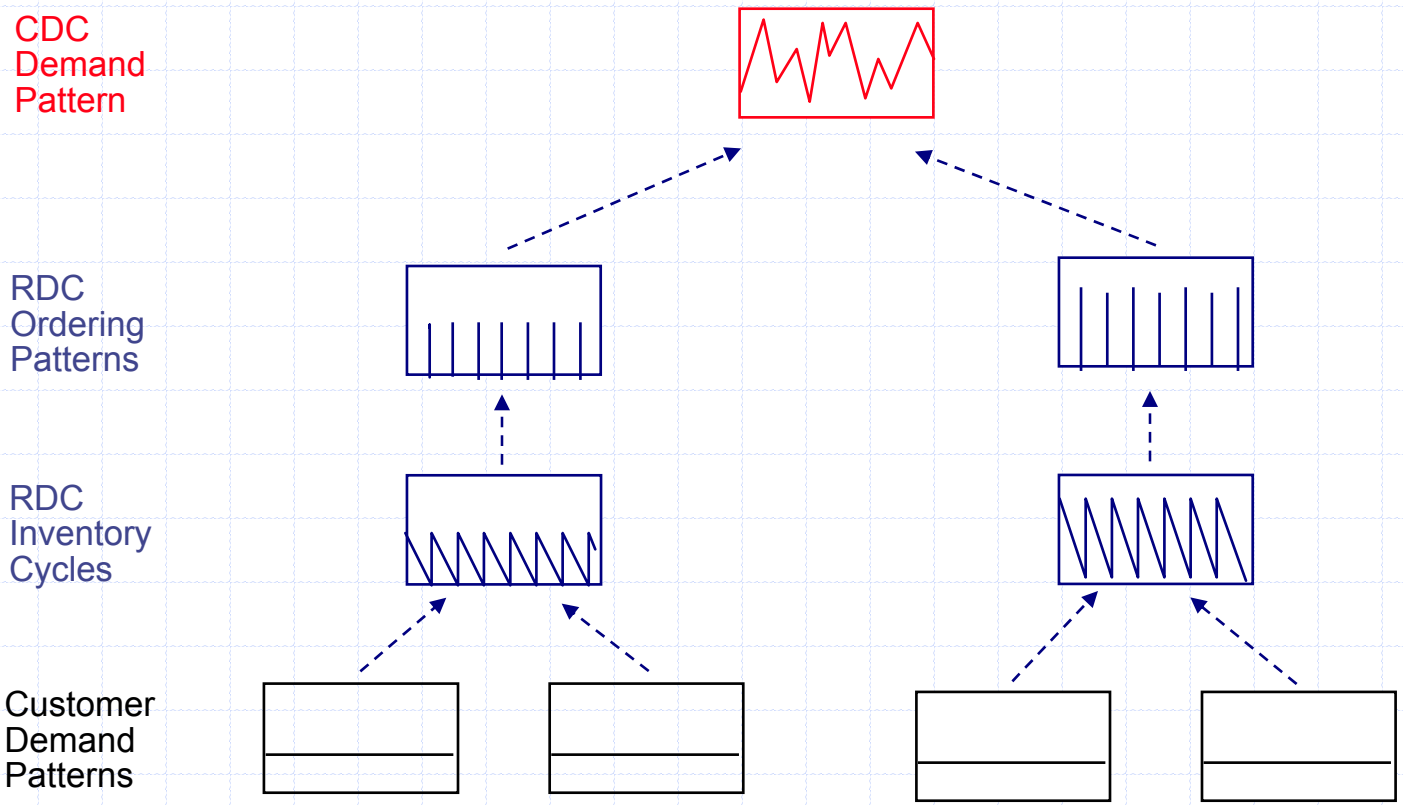
A Multi-Echelon Inventory System



What if I Use Traditional Techniques?

- In multi-echelon inventory systems with decentralized control, lot size / reorder point logic will:
  - Create and amplify "lumpy" demand
  - Lead to the mal-distribution of available stock, hoarding of stock, and unnecessary stock outs
  - Force reliance on large safety stocks, expediting, and re-distribution.

Impact of Multi-Echelons



Layers of Inventory Create Lumpy Demand

What does a DRP do?

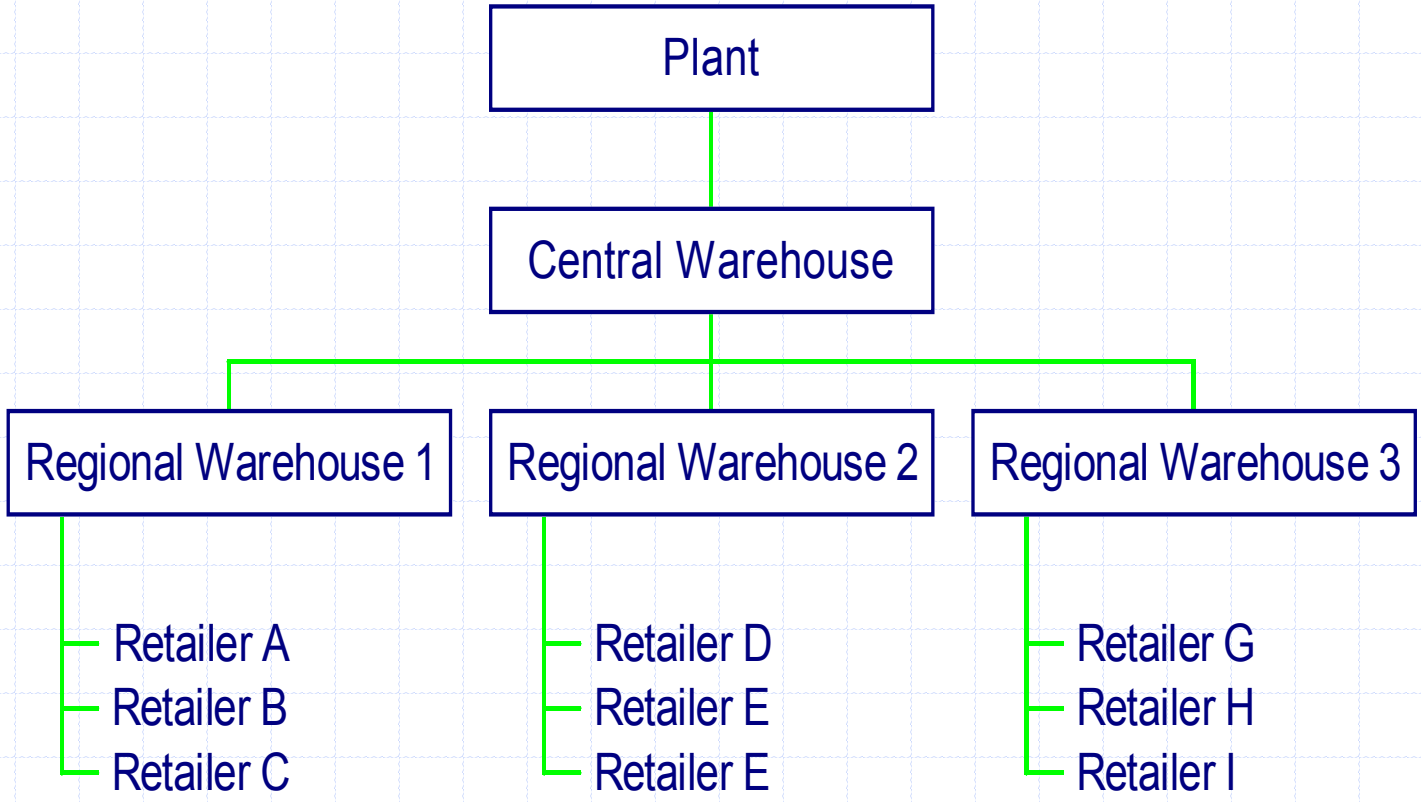
- Premises
  - Inventory control in a distribution environment
  - Many products, many stockage locations
  - Multi-echelon distribution network
  - Layers of inventory create "lumpy" demand
- Concepts
  - Dependent demand versus independent demand
  - Requirements calculation versus demand forecasting
  - Schedule flow versus stockpile assets
  - Information replaces inventory

"DRP is simply the application
of the MRP principles and techniques
to distribution inventories"
Andre Martin

DRP Requirements

- Information Requirements:
  - Base Level Usage Forecasts
  - Distribution Network Design
  - Inventory Status
  - Ordering Data
- DRP Process:
  - Requirements Implosion
  - Net from Gross Requirements
  - Requirements Time Phasing
  - Planned Order Release

A Distribution Network Example

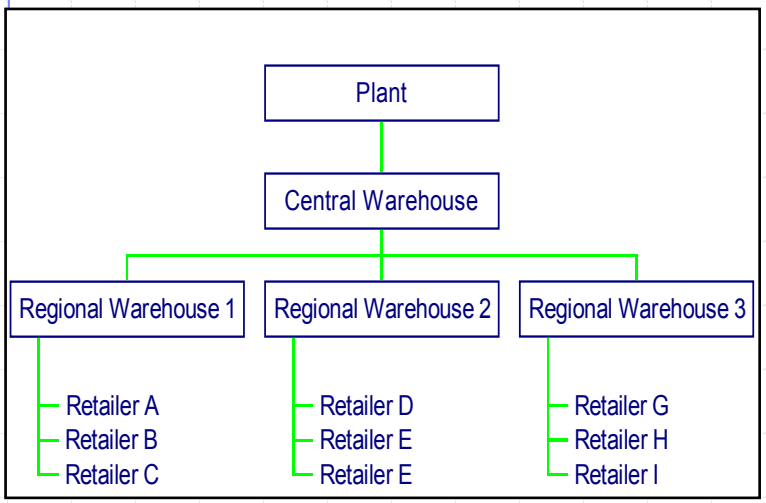


Example: The DRP Plan

Regional Warehouse One
Q=50 , SS=15 , LT=1

	NOW	1	2	3	4	5	6	7	8
Period Usage		25	25	25	25	25	25	25	25
Gross Rqmt		40	40	40	40	40	40	40	40
Begin Inv		50	25	50	25	50	25	50	25
Sched Rcpt		0	0	0	0	0	0	0	0
Net Rqmt			15		15		15		15
Plan Rcpt		0	50	0	50	0	50	0	50
End Inv	50	25	50	25	50	25	50	25	50
POR		50		50		50		50	

The DRP Plan



Central Warehouse Facility									
Q=200, SS=0, LT=2	NOW	1	2	3	4	5	6	7	8
Period Usage		100	20	50	30	100	0	100	0
Gross Rqmt		100	20	50	30	100	0	100	0
Begin Inv		150	50	30	180	150	50	50	150
Sched Recpt		0	0	0	0	0	0	0	0
Net Rqmt		-	-	20	-	-	-	50	-
Planned Recpt		0		200	0	0	0	200	0
End Inv	150	50	30	180	150	50	50	150	150
Planned Order		200				200			
Regional Warehouse One									
Q=50, SS=15, LT=1	NOW	1	2	3	4	5	6	7	8
Period Usage		25	25	25	25	25	25	25	25
Gross Rqmt		40	40	40	40	40	40	40	40
Begin Inv		50	25	50	25	50	25	50	25
Sched Recpt		0	0	0	0	0	0	0	0
Net Rqmt		-	15	-	15	-	15	-	15
Planned Recpt		0	50	0	50	0	50	0	50
End Inv	50	25	50	25	50	25	50	25	50
Planned Order		50		50		50		50	
Regional Warehouse Two									
Q=30, SS=10, LT=1	NOW	1	2	3	4	5	6	7	8
Period Usage		10	10	10	10	20	20	20	20
Gross Rqmt		20	20	20	20	30	30	30	30
Begin Inv		20	10	30	20	10	20	30	10
Sched Recpt		0	0	0	0	0	0	0	0
Net Rqmt		-	10	-	-	20	10	-	20
Planned Recpt			30	0	0	30	30	0	30
End Inv	20	10	30	20	10	20	30	10	20
Planned Order		30			30	30		30	
Regional Warehouse Three									
Q=20, SS=10, LT=1	NOW	1	2	3	4	5	6	7	8
Period Usage		5	15	10	10	0	15	0	15
Gross Rqmt		15	25	20	20	10	25	10	25
Begin Inv		15	10	15	25	15	15	20	20
Sched Recpt		0	0	0	0	0	0	0	0
Net Rqmt		-	15	5	-	-	10	-	5
Planned Recpt		0	20	20	0	0	20	0	20
End Inv	15	10	15	25	15	15	20	20	25

Example: The DRP Plan

Regional Warehouse Two
Q=30 , SS=10 , LT=1

	NOW	1	2	3	4	5	6	7	8
Period Usage		10	10	10	10	20	20	20	20
Gross Rqmt		20	20	20	20	30	30	30	30
Begin Inv		20	10	30	20	10	20	30	10
Sched Rcpt		0	0	0	0	0	0	0	0
Net Rqmt			10			20	10		20
Plan Rcpt		0	30	0	0	30	30	0	30
End Inv	20	10	30	20	10	20	30	10	20
POR		30			30	30		30	

Example: The DRP Plan

Regional Warehouse Three
Q=20 , SS=10 , LT=1

	NOW	1	2	3	4	5	6	7	8
Period Usage		5	15	10	10	0	15	0	15
Gross Rqmt		15	25	20	20	10	25	10	25
Begin Inv		15	10	15	25	15	15	20	20
Sched Rcpt		0	0	0	0	0	0	0	0
Net Rqmt			15	5			10		5
Plan Rcpt		0	20	20	0	0	20	0	20
End Inv	15	10	15	25	15	15	20	20	25
POR		20	20			20		20	

The DRP Plan for All Locations

Rolling Up Orders

	NOW	1	2	3	4	5	6	7	8
CENTRAL									
Period Usage		100	20	50	30	100	0	100	0
POR		200				200			
REGION ONE									
Period Usage		25	25	25	25	25	25	25	25
POR		50		50		50		50	
REGION TWO									
Period Usage		10	10	10	10	20	20	20	20
POR		30			30	30		30	
REGION THREE									
Period Usage		5	15	10	10	0	15	0	15
POR		20	20			20		20	

Example: The DRP Plan

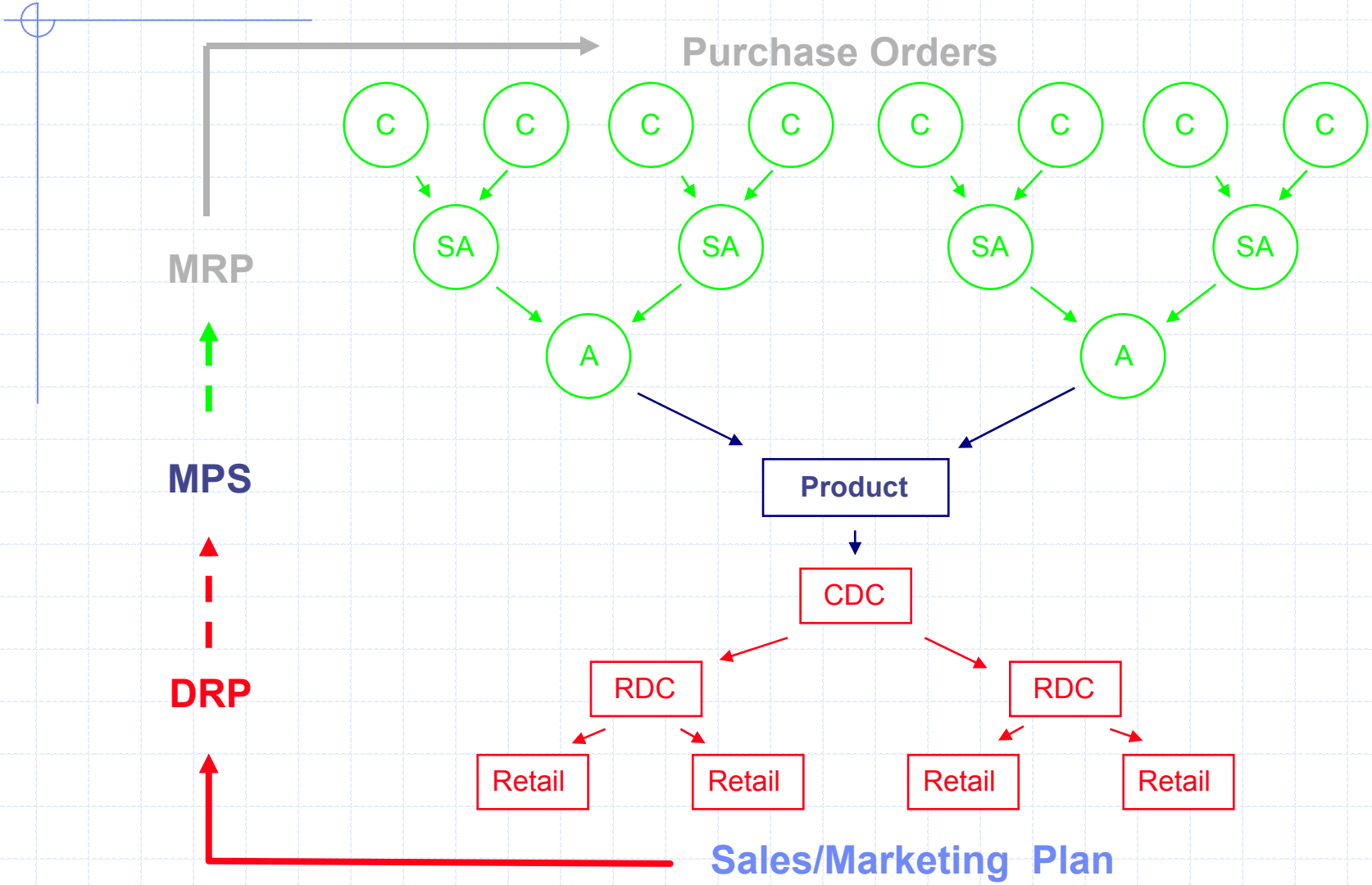
Central Warehouse
Q=200 , SS=0 , LT=2

	NOW	1	2	3	4	5	6	7	8
Period Usage		100	20	50	30	100	0	100	0
Gross Rqmt		100	20	50	30	100	0	100	0
Begin Inv		150	50	30	180	150	50	50	150
Sched Rcpt		0	0	0	0	0	0	0	0
Net Rqmt				20				50	
Plan Rcpt		0	0	200	0	0	0	200	0
End Inv	150	50	30	180	150	50	50	150	150
POR		200				200			

Results and Insights

- DRP is a scheduling and stockage algorithm
  -- it replaces the forecasting mechanism above the base inventory level
- DRP does not determine lot size or safety stock
  -- but these decisions must be made as inputs to the process
- DRP does not explicitly consider any costs
  -- but these costs are still relevant the user must evaluate trade-offs
- DRP systems can deal with uncertainty
  -- using "safety time" and "safety stock"

MRP / DRP Integration



Evolution of Inventory Management

- Traditional Replenishment Inventory:
  - Lot Size/ Order Point Logic
  - Single item focus
  - Emphasis on cost optimization
  - Long run, steady state approach
- The MRP / DRP Approach:
  - Scheduling emphasis
  - Focus on quantities and times, not cost
  - Multiple, inter-related items and locations
  - Simple heuristic rules

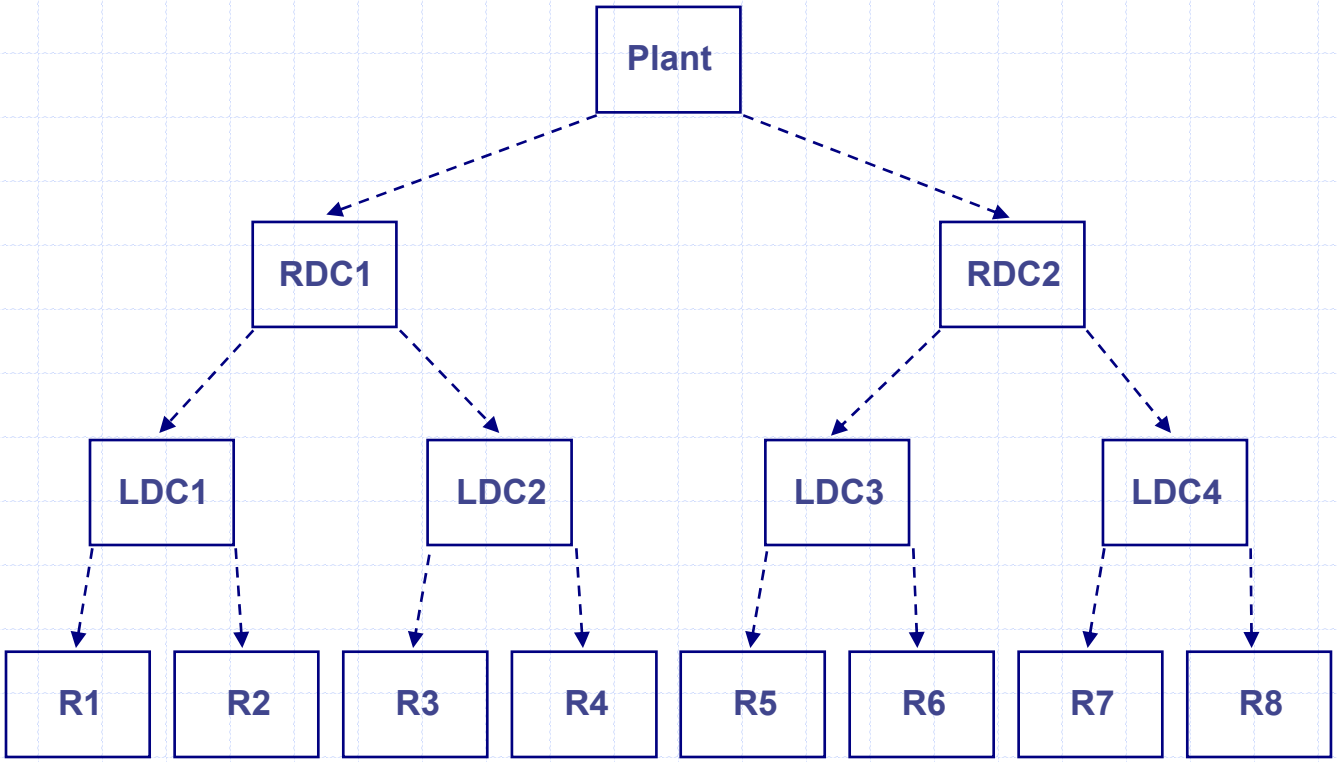
Evolution of Inventory Management

- MRP / DRP have limited ability to deal with:
  - Capacity restrictions in production and distribution
  - "set-up" costs
  - fixed and variable shipping costs
  - alternative sources of supply
  - network transshipment alternatives
  - expediting opportunities
- Next Steps in MRP/DRP
  - Establish a time-phased MRP/MPS/DRP network
  - Apply optimization tools to the network
  - Consider cost trade-offs across items, locations, and time periods
  - Deal with shortcomings listed above

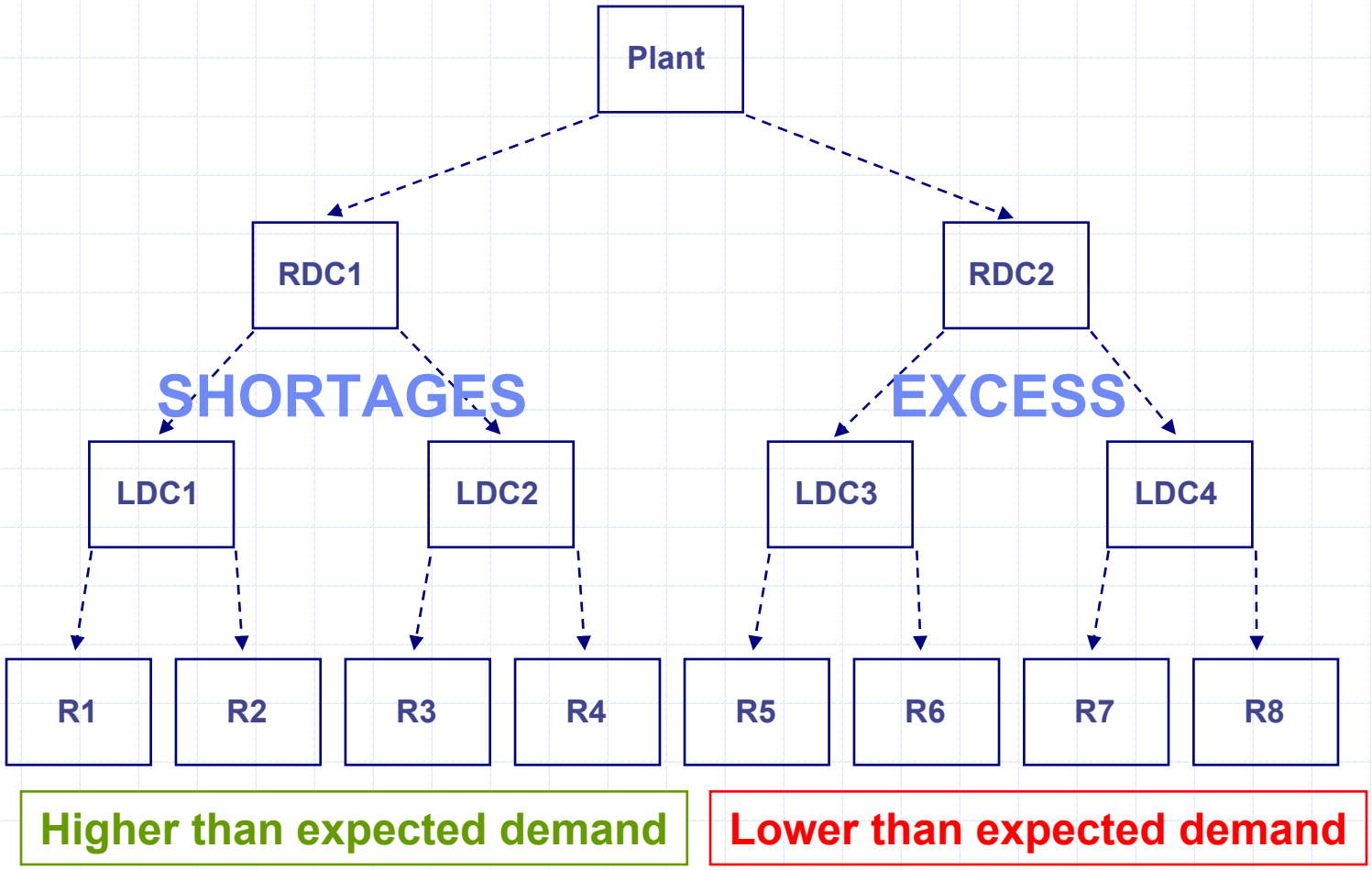
A DRP Network Plan

What happens when actual demand in the short term doesn't follow the forecast exactly…..

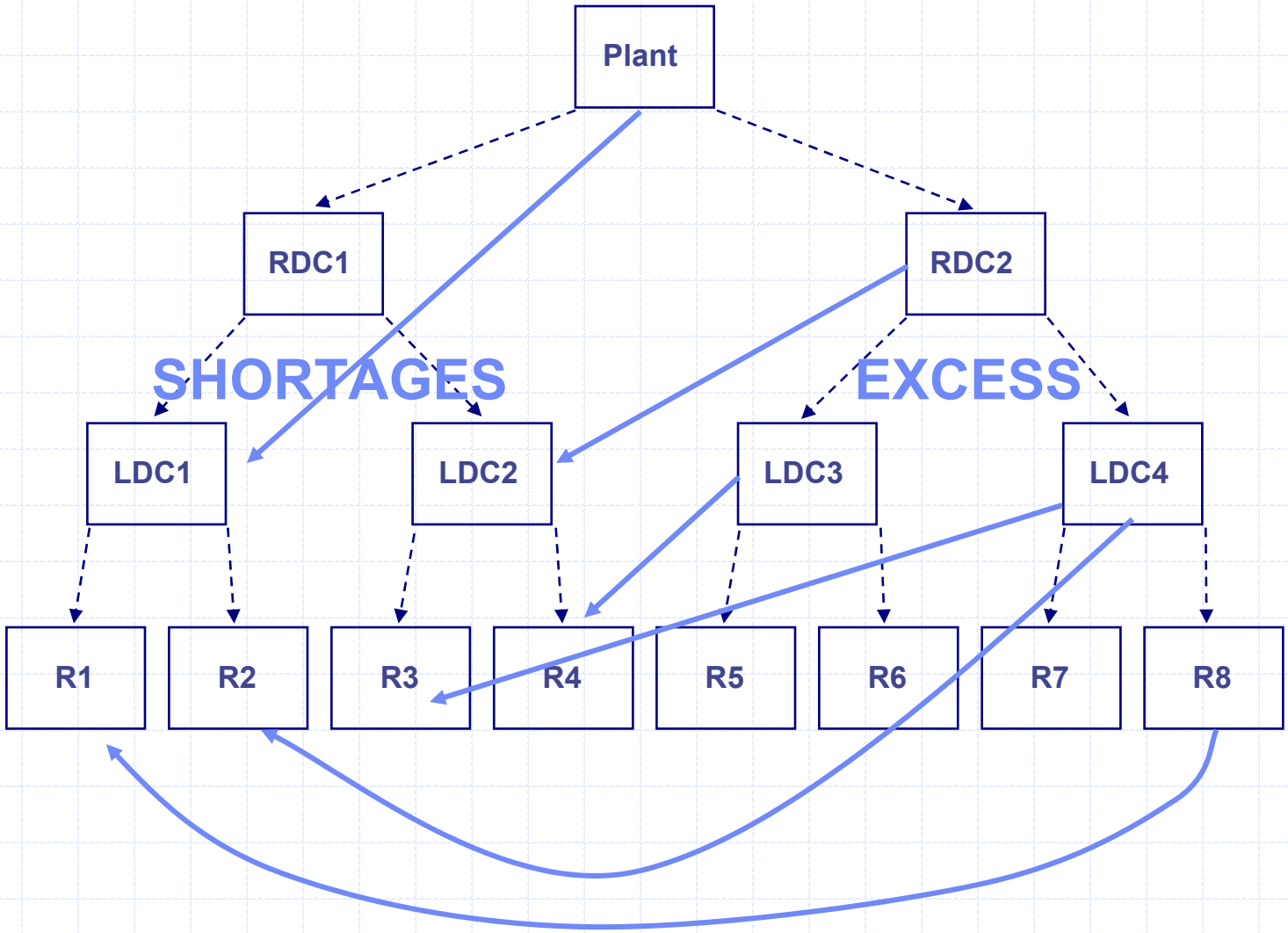
How should I re-deploy my inventory to take the maximum advantage of what I do have?



A DRP Network Reality



Optimal Network Utilization



Information and Control Impacts

	Centralized Control	**Decentralized Control**
Global Information	◆Vendor Managed Inventory (VMI) ◆DRP (some cases) ◆Extended Base Stock Control Systems	◆DRP (most cases) ◆Base Stock Control
Local Information	N/A	◆Standard Inventory Policies: (R,Q), (s,S) etc.