Designing a Workload Scenario for Benchmarking Message-Oriented Middleware

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Overview

I. Introduction
II. Workload Requirements and goals of the SPECjms benchmark
III. Application Scenario for SPECjms
IV. Implementation Details
V. Summary

Message Oriented Middleware (MOM)

- Used in many business domains
  - Financial services and enterprise applications
  - Health care
  - Supply chain
  - ...
- And in many technologies
  - Enterprise Service Bus (ESB)
  - Service Oriented Architecture (SOA)
  - Enterprise Application Integration (EAI)
  - ...
- Increasing importance → **Need for benchmark**

Requirements of a MOM benchmark

- Scenario **representative** of real-world applications.
- Exercise **all critical** services provided by platforms.
- **Not** optimized for **a specific product**.
- **Reproducible results**.
- No inherent **scalability** limitations.

Current State of MOM Benchmarking

- **Many proprietary benchmarks** for MOM servers
  - Used for performance testing and product comparisons

However:

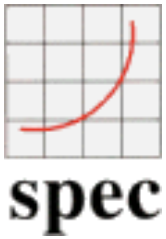
- These benchmarks do not meet all of the defined requirements

  Typically they...
  - concentrate on stressing individual MOM features, and
  - do not provide a comprehensive and representative workload for evaluating the overall MOM performance
- Currently no **industry-standard benchmark** for MOM Benchmarking → **SPECjms 2007**

What is SPECjms 2007?

- **World's first industry standard benchmark for MOM** products supporting Java Message Service (JMS)

- Developed by the SPEC OSG-Java subcommittee with the participation of:
  - IBM
  - TU Darmstadt
  - Sun
  - Sybase
  - BEA
  - Apache
  - Oracle
  - JBoss



Goals of SPECjms 2007

I. Provide a **standard workload and metrics** for measuring and evaluating JMS-based platforms

II. Provide a **flexible framework** for JMS performance analysis

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Categories of Workload Requirements

- Representativeness
- Comprehensiveness
- Focus
- Scalability
- Configurability

Categories of Workload Requirements

- **Representativeness**
- Comprehensiveness
- Focus
- **Scalability**
- **Configurability**

Representativeness

The goal:

- Allow users to relate the observed behavior to their own applications and environments.
- Should simulate the way platform services are exercised in real-life systems.

Therefore:

- It should be based on a representative workload scenario:
  - Communication style and the types of messages should represent a *typical transaction mix*.

Scalability

- Dimensions of scaling the workload :
  - **Horizontal scaling**:
    - De/Increase the number of destinations (queues and topics)
    - Keep the traffic per destination constant
  - **Vertical scaling:**
    - De/Increase traffic per destination
    - Keep the number of destinations fixed
- Preserve real-life relationships in modeled scenario

- **Additionally:** Support for freeform scaling,
  e.g. user defined traffic per destination and number of destinations

Configurability I

- Provide a flexible performance analysis tool:
  - Allows users to configure and customize the workload, e.g. for research purposes
- Produce and publish standard results e.g for marketing purposes

Therefore:

- Need for a framework which supports
  - tuning,
  - analyzing and
  - optimizing

  performance of certain features / platforms

Configurability II

- A benchmark framework should allow:
  - precise **configuration of workload and transaction mix**
  - to **switch off business interactions**
    (implies that interactions should be decoupled)

- Providing such a configurability is a great challenge:
  - ***Freeform mode:***
    Design and implement interactions so that they can be run in different combinations depending on the desired transaction mix
  - ***Standard mode:***
    It has to be ensured, that the interactions always behave like defined in the application scenario

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The Application Scenario

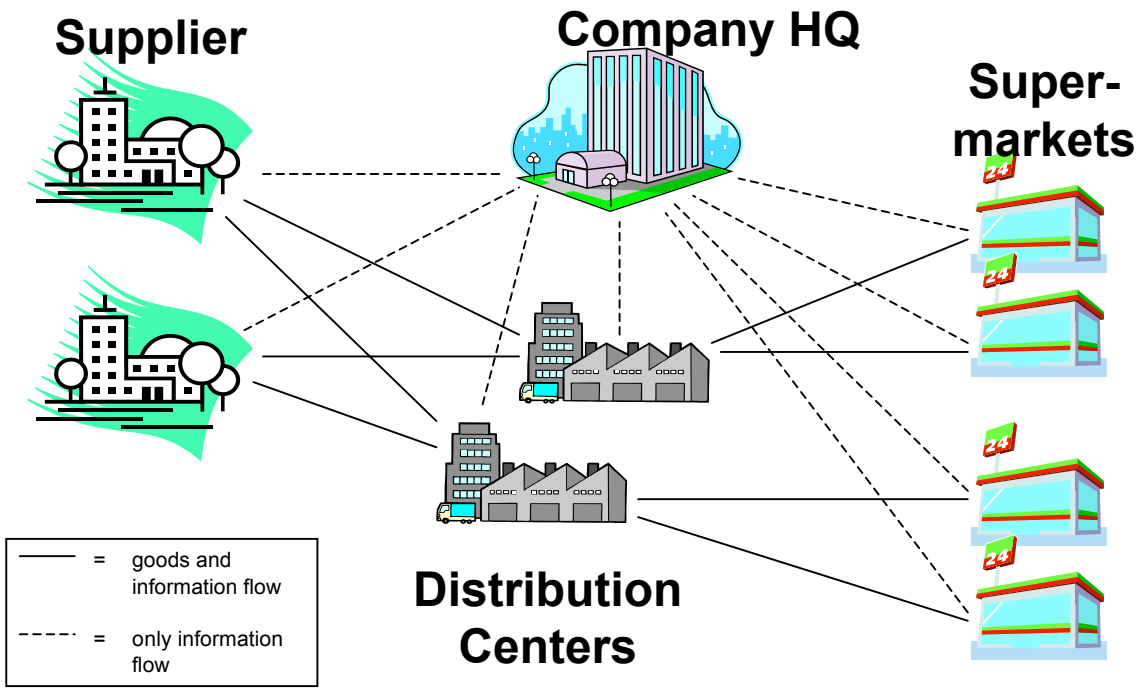
- Represents a **supply chain** of a supermarket company.
- **Participants:**
  - Headquarters (HQ)
  - Supermarkets (SM)
  - Distribution Centers (DC)
  - Suppliers (SP).
- Based on the previously discussed requirements.

The Application Scenario

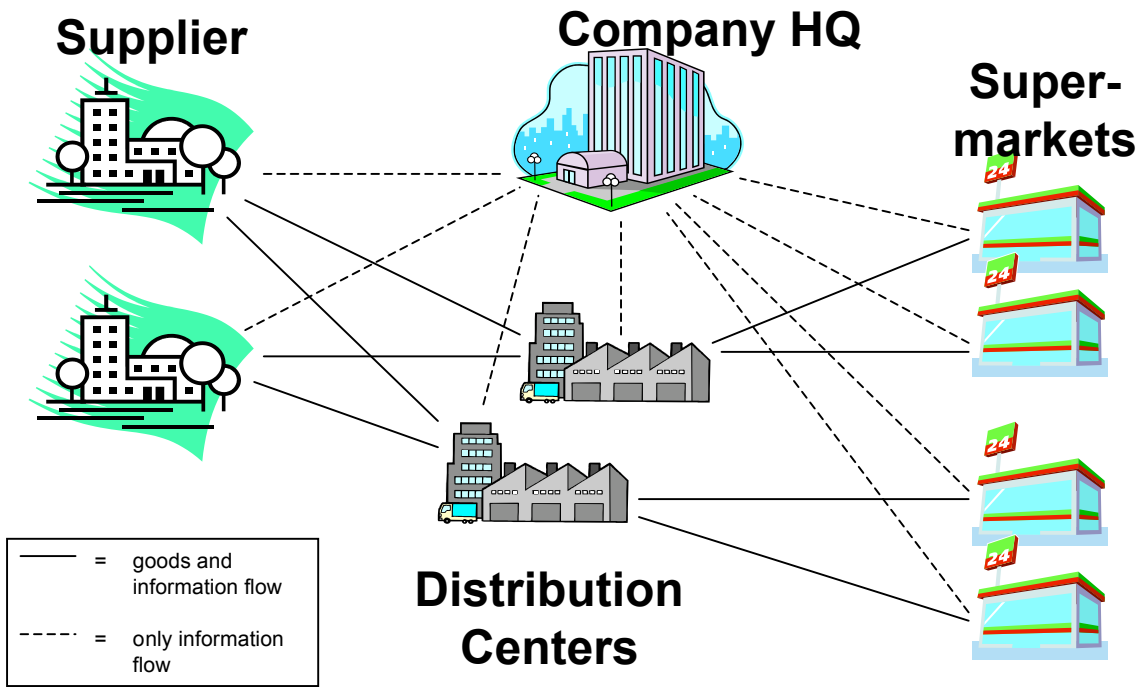
Why again a Supply Chain Scenario?

- Excellent basis for defining different interactions:
  Many destinations, use cases, ...
- Typical real word application
- Importance of performance (RFID!)
- Allows scaling the workload in a natural way:
  - *Horizontal:* e.g. scale the number of SMs
  - *Vertical:* e.g. scale amount of products sold per SM

Participants



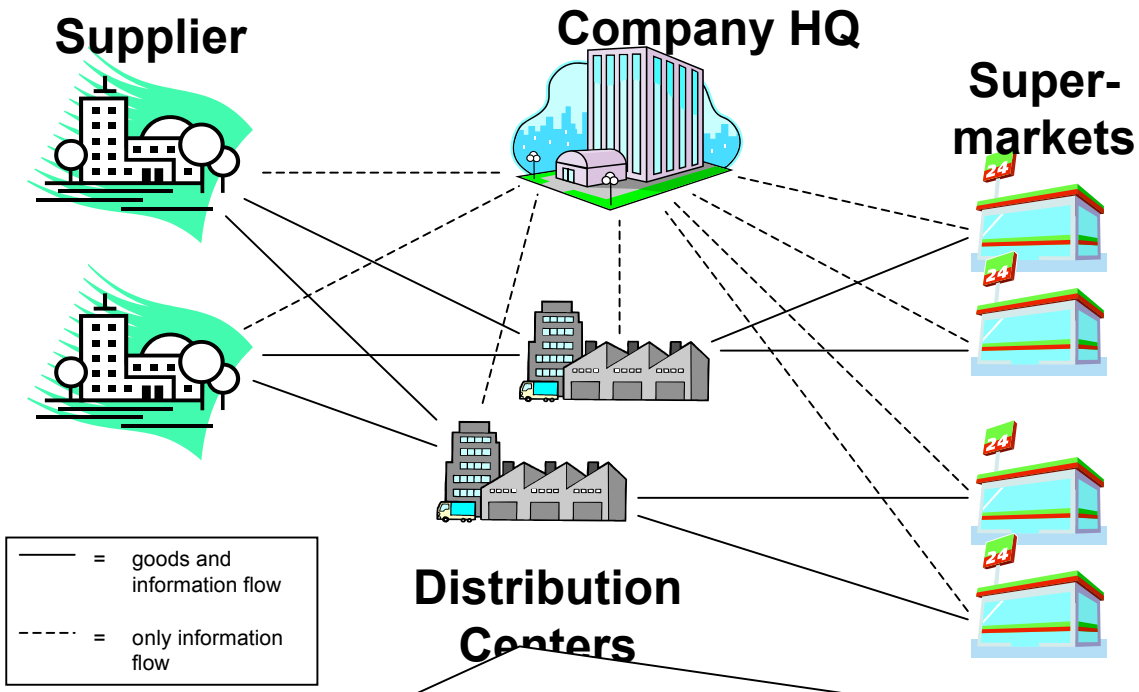
Participants - Supermarkets



Supermarket (SM)

- sells goods to end customers.
- manages its inventory.
- every supermarket offers different products.
- every supermarket is supplied by exactly one of the distribution centers.

Participants - Distribution Center



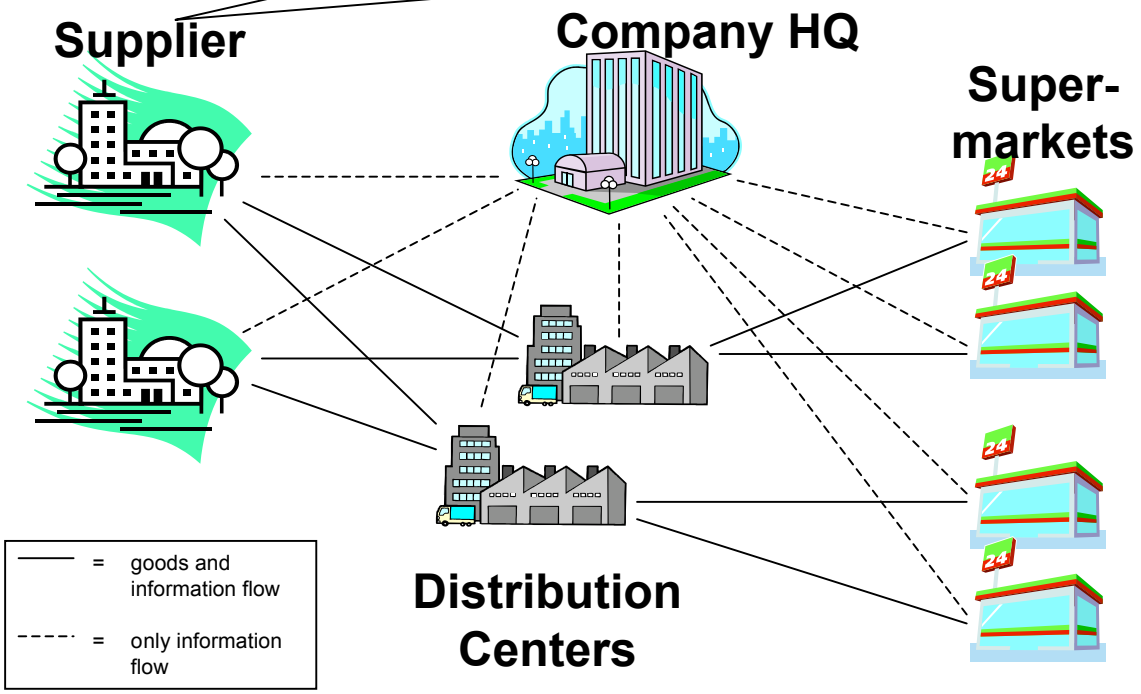
Distribution Center (DC)

- supplies the supermarket stores which sell goods to end customers.
- responsible for a set of stores in a given area.
- is supplied by external suppliers.

Participants – Suppliers

Supplier (SP)

- deliver goods to distribution centers (based on an offer of the supplier).
- not every supplier offers the same products.
- offers either all products of a given product family or none of them.



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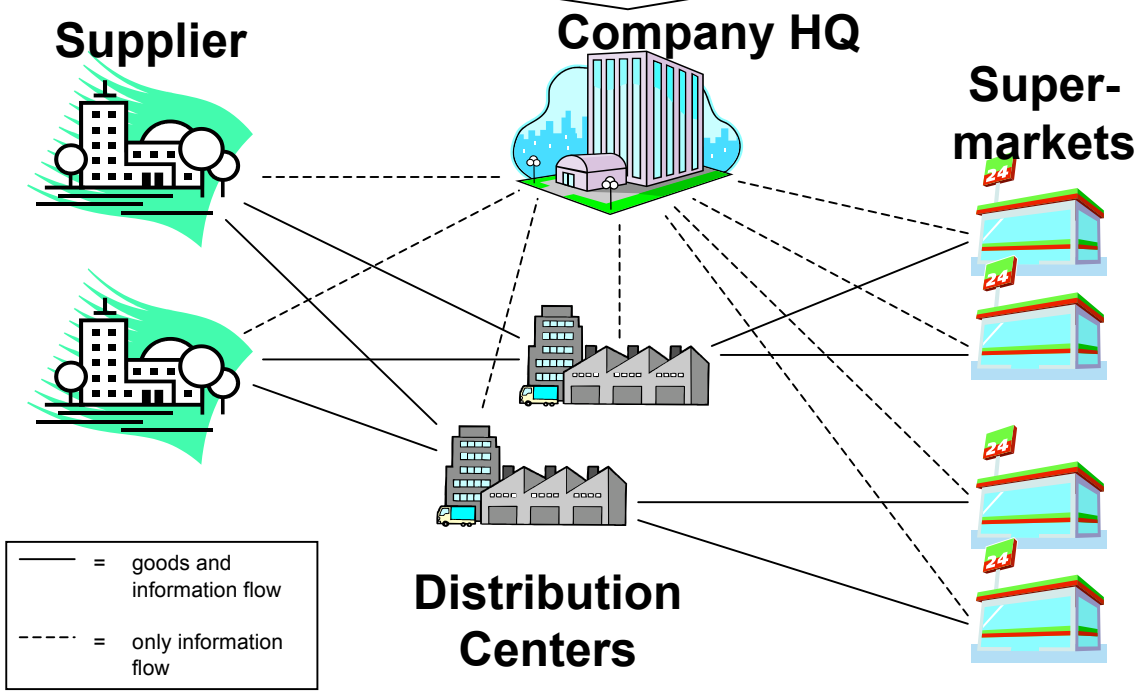
Company HQ

- manages the accounting of the company.
- manages information about the goods and products.
- manages selling prices.
- monitors the flow of goods and money in the supply chain.



Business Interactions

The following interactions are part of the scenario:

1. Order / Shipment Handling (SM / DC)
2. (Purchase) Order / Shipment Handling (DC / SP)
3. Price Updates
4. Inventory Management
5. Sales Statistics Collection
6. Product Announcements
7. Credit Card Hotlists

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The following interactions are part of the scenario:

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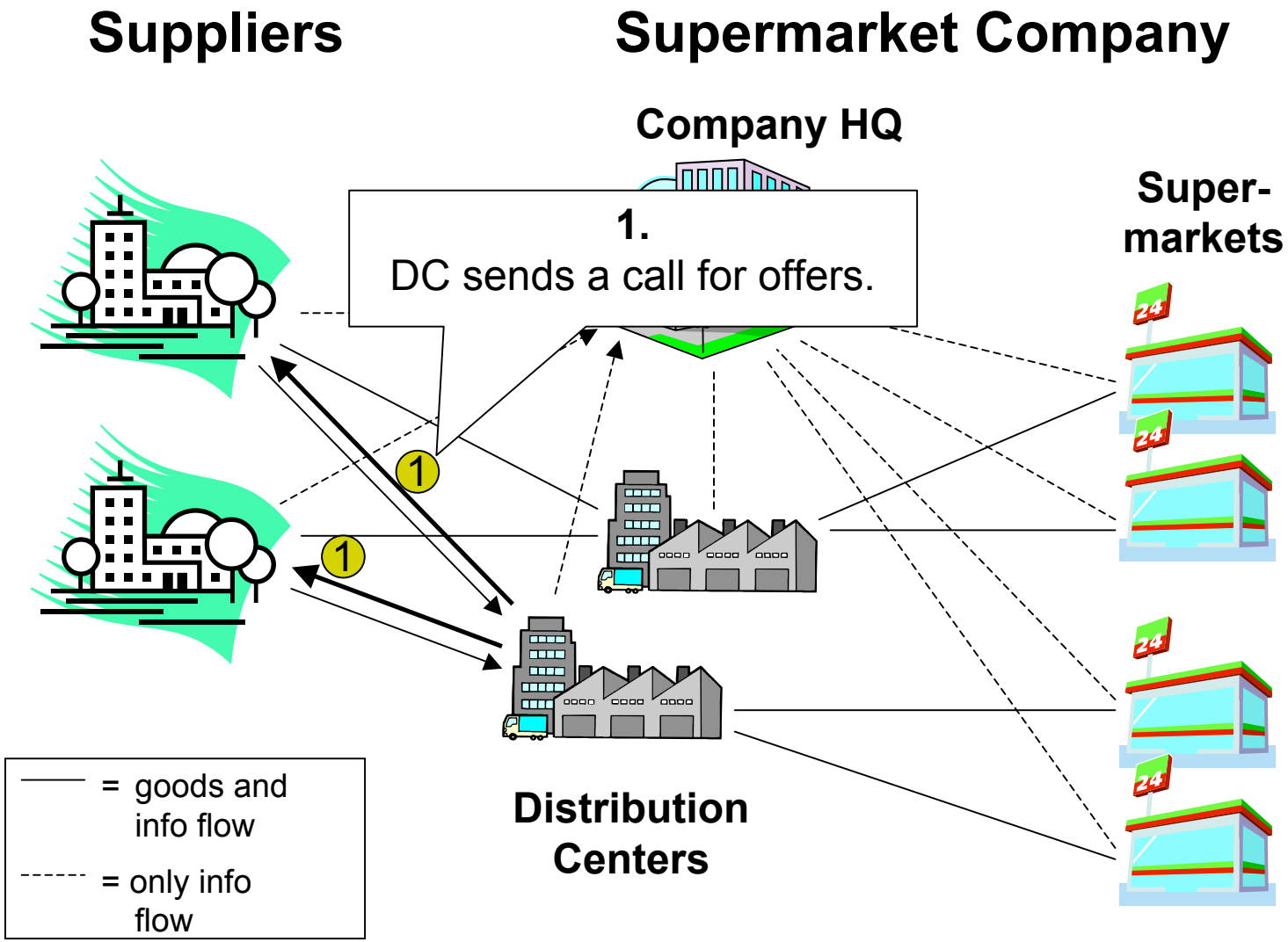
Example: Interaction 2

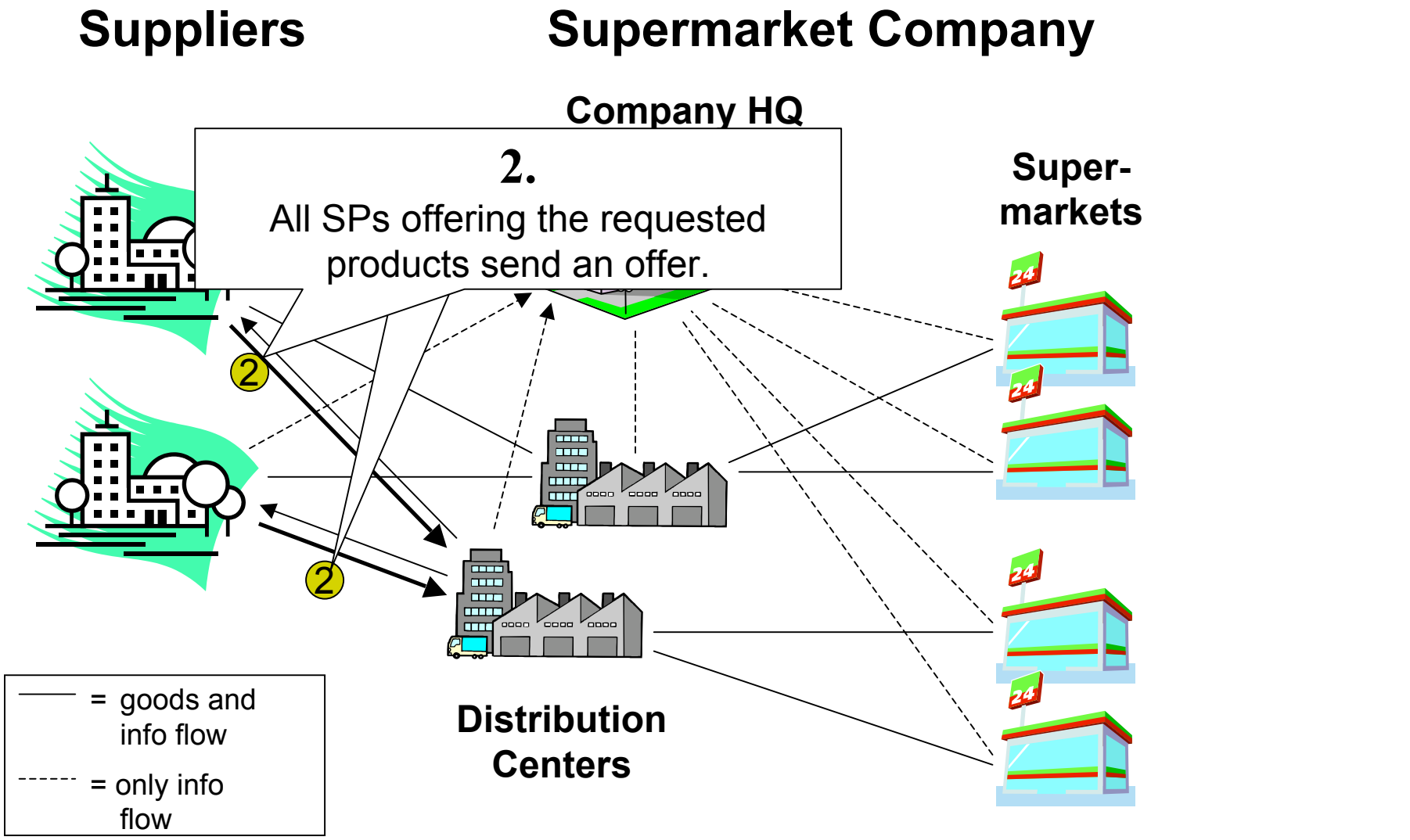
Purchase Order / Shipment Handling (DC & SPs)

- Point-to-Point **and** Publish/Subscribe communication.
- Inter company communication.
- Includes **six steps**

Interaction 2
Purchase Order / Shipment Handling



Interaction 2
Purchase Order / Shipment Handling



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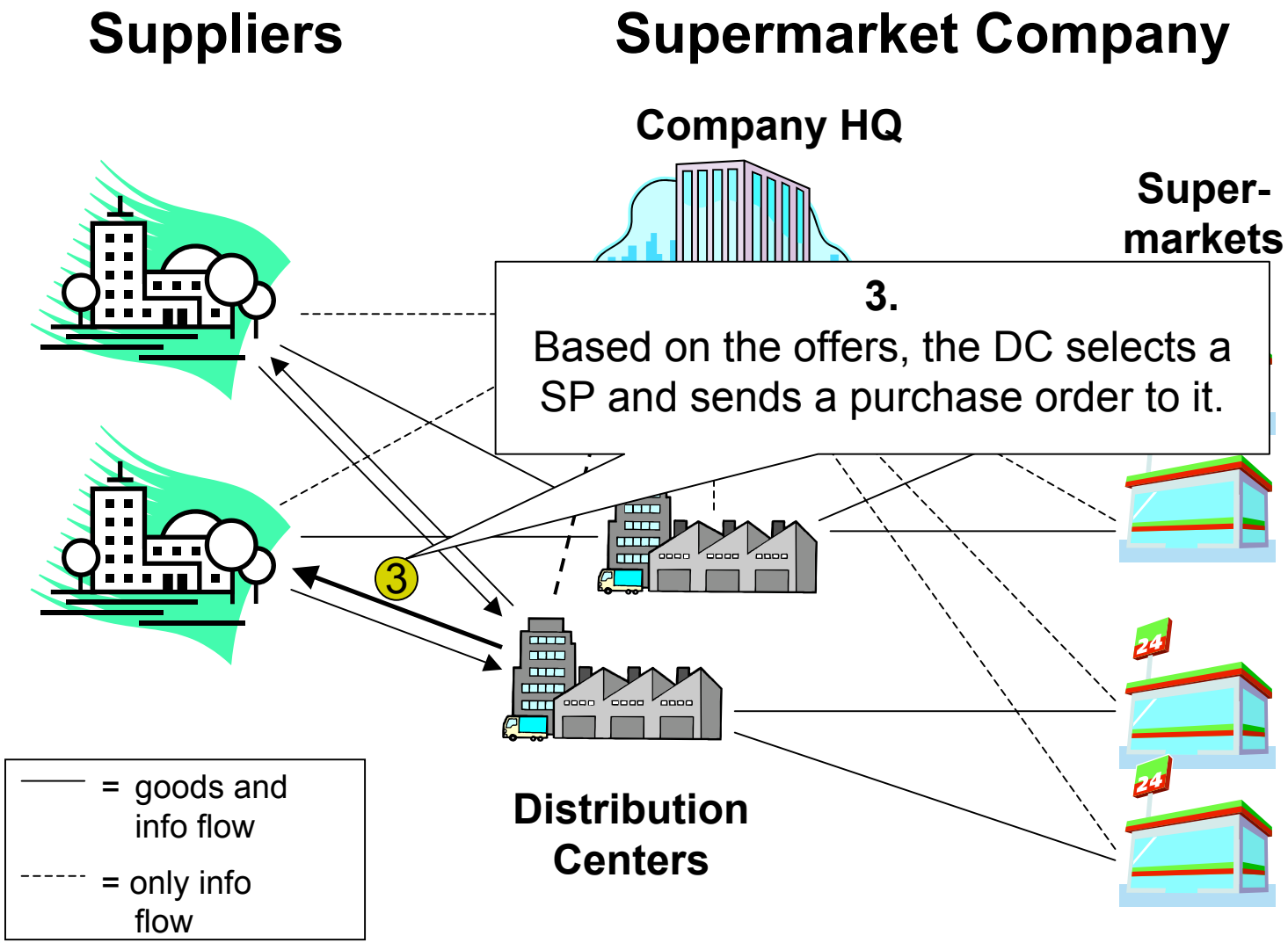

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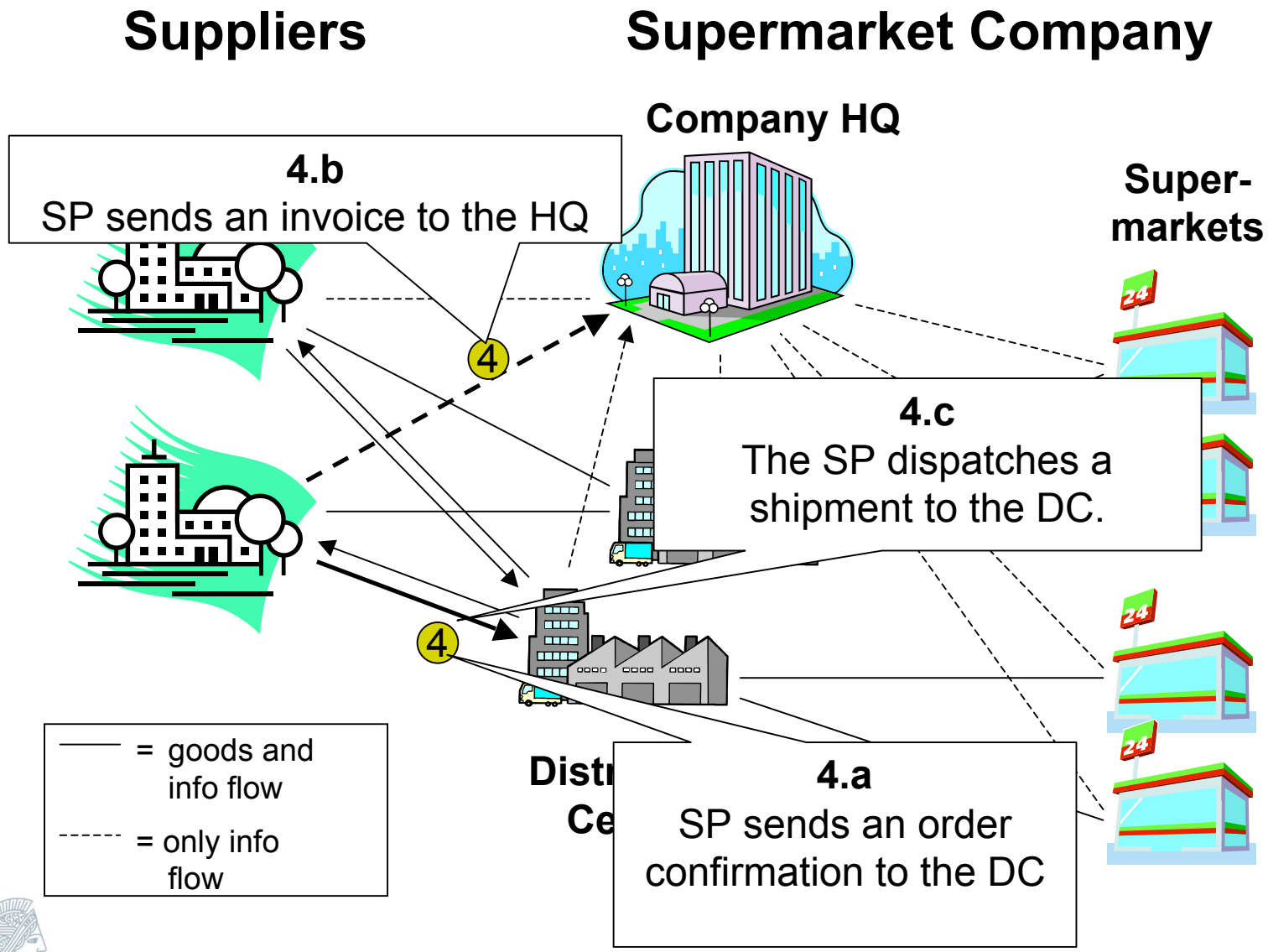

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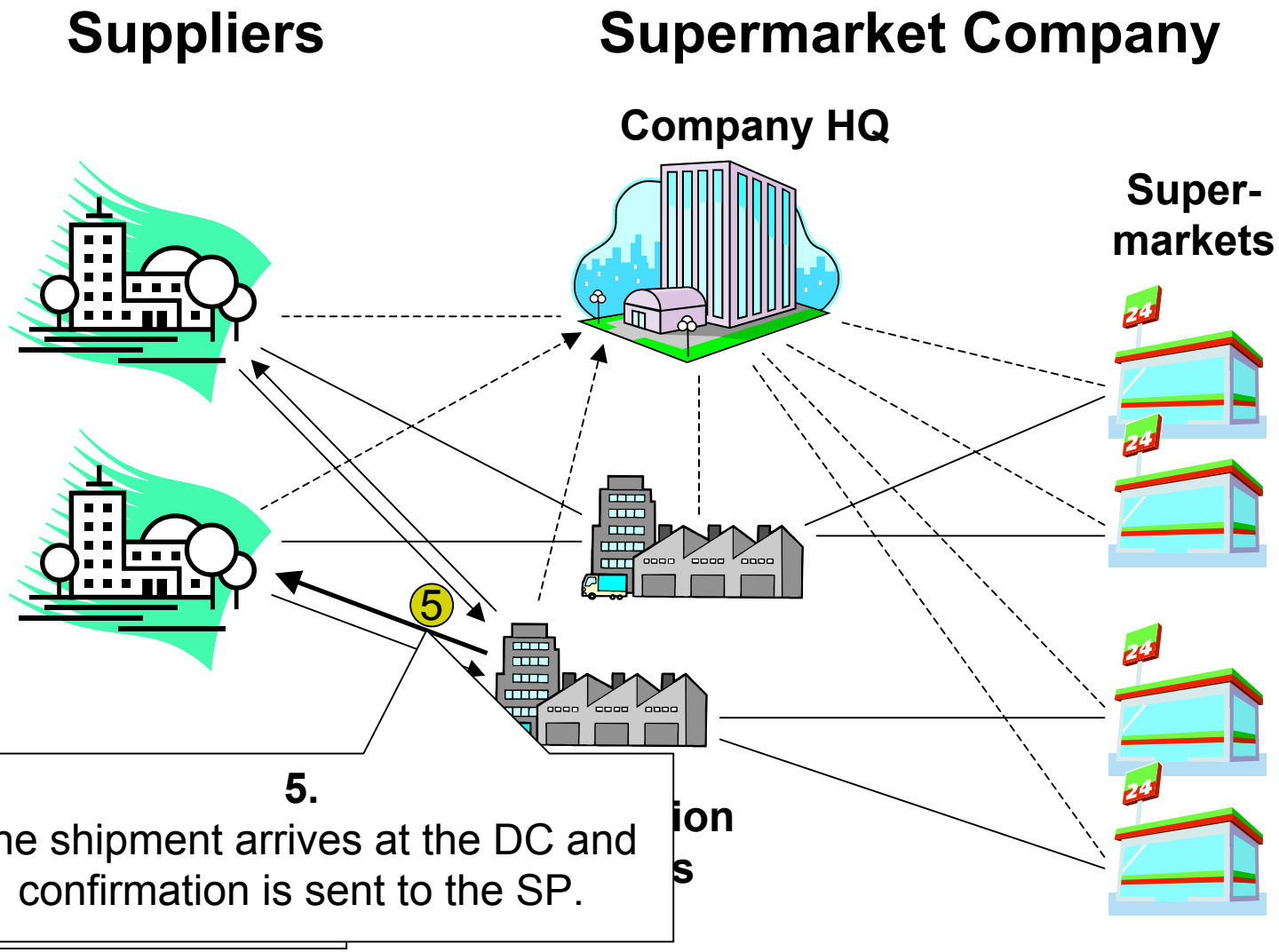

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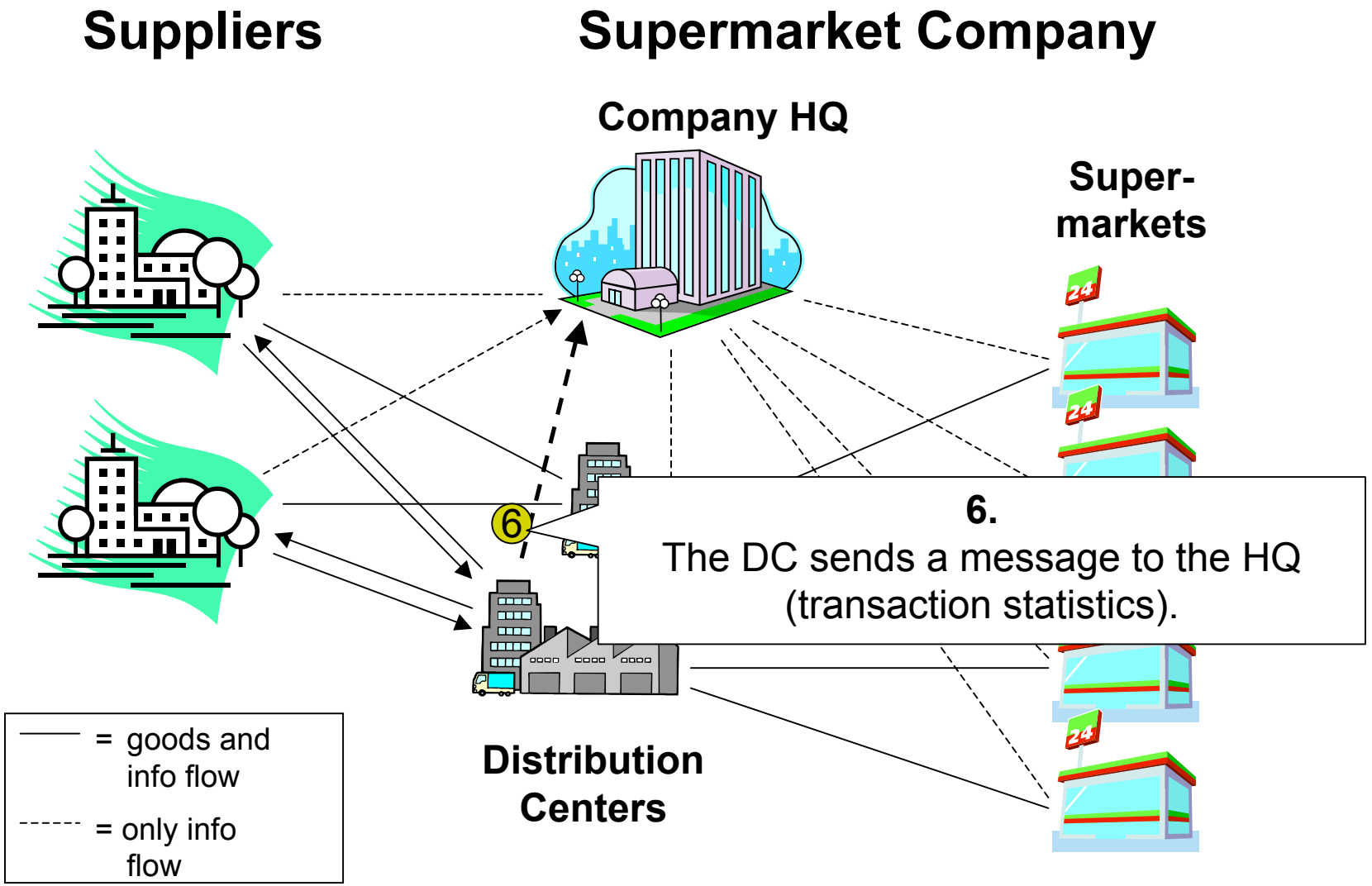

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Message Types and Destinations

19 different messages are defined:

- Three different sizes per message (small, medium, large) with a certain probability
- Acknowledgment mode:
  - Standard: AUTO_ACKNOWLEDGMENT
    (can be changed in several interactions)
- All messages types supported by the JMS Specification excepted ByteMessages
- (Non-)Persistent, (Non-)Transactional, Durable, ...

Message Types and Destinations

- Number of queues per location instance:

Location	No. of queues
SM	3
SP	2
HQ	4
DC	6

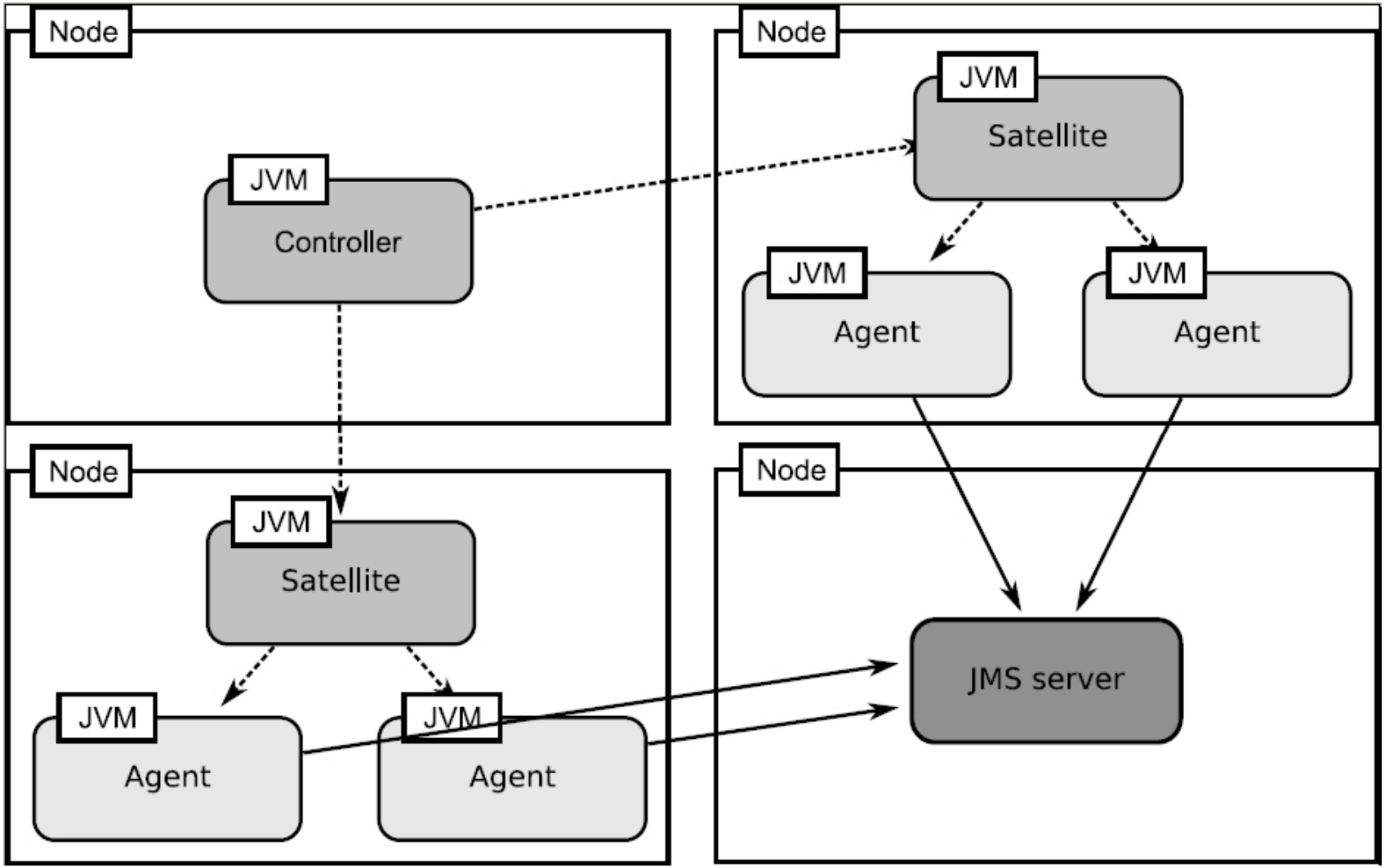
- Number of topics:
  3 + *one for every product family*

Driver Framework

- Many locations represented by many event handlers (message consumers)
- Event handlers may be distributed across many physical machines.

- **Reusable driver framework** addresses this issues without any inherent scalability limitations.
- **Plain Java**
- **Maximum choice** in laying out workload to achieve maximum performance.

Driver Framework



A Flexible Framework for Performance Analysis

- Allows to **configure and customize** the workload / transaction mixes
- Provides **three different topologies** corresponding to three different modes in which the benchmark can be run:
  - Vertical
  - Horizontal
  - Freeform
- **Many features**

A Flexible Framework for Performance Analysis

Some features:

- Number of physical locations (HQ, SM, DC, SP) emulated.
- Number of agents representing a single physical location.
- Number of event handlers in an agent of each type.
- Number of driver instances for each interaction.
- Total number of invocations of each interaction (as an alternative to specifying a rate).
- Message size distributions for each interaction.
- The driver nodes on which agents are run.
- Number of JVMs run on each node and the way agents are distributed among them.
- Number of javax.jms.Connection objects shared amongst event handler classes within a single agent.
- ....

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Summary

- The presented scenario models a set of interactions in the **supply chain** of a supermarket company.
- These interactions are used as a basis in SPEC's new SPECjms benchmark.
- SPECjms will be the **world's first industry-standard benchmark for MOM products.**
- SPECjms can be used to **stress and evaluate** the different aspects of JMS performance.
- SPECjms is **more than a benchmark:**
  Offers also a performance analysis tool for JMS-based infrastructures.

Thanks for your attention