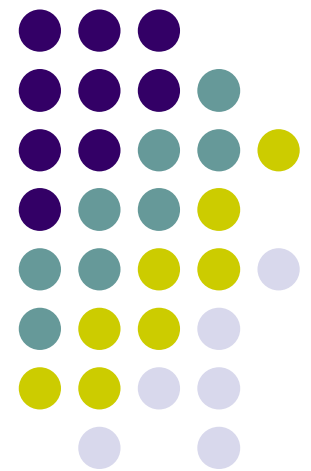


RFID Technology and Manufacturing Automation

Govindarajan Srimathveeravalli



Overview



- Prologue
- Inventory Management
 - Definitions
 - Analysis Methods
- Importance of Inventory Management – Case Study
- Radical Approaches
- Traditional methods of tracking and material handling
- Intro to RF technology
- Terminology
- How it works
- Positioning
- Advantages

Production Planning and Control



- Motivation

Cost – Quality – Lead Time

- Aim

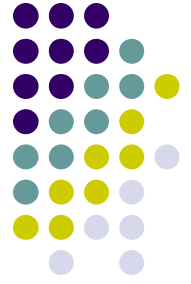
- Reduced Inventory
- Reduce Unutilized Capacity
- Reduction of Costs

Material Requirements Planning



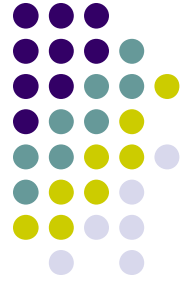
- Bill of Materials
 - Required to Manufacture Part
 - Parts Explosion
- Demand
- Common Use Items
 - Oil, Paint, Repairs Items
- On Hand Inventory
- Lead Time





Inventory Management

- Control of stored resources, like
 - Work In Progress
 - Raw Materials
 - Finished Goods
 - Bill of Materials
 - Auxiliary Equipment and Materials
- To provide for future/current demand
- Two Questions
 - When to ?
 - How much ?
- Logistics



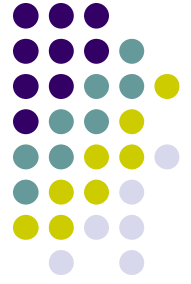
Analysis Techniques

- ABC analysis
 - Classify material requirements into 3 groups (Top 80%, Next 15%, Next 5%)
 - Annual dollar volume = Annual demand x Cost
- Typical Costs
 - Holding and Carrying costs
 - Setup and Ordering costs
- Economic Order Quantity (EOQ)
 - Assumptions
 - Stocks available immediately
 - Constant rate of demand



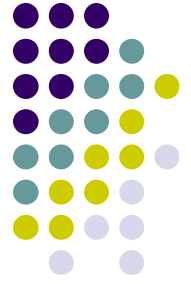
UPS – A Case Study

- Alcatel
 - Equipment, documents etc
 - 600 – 800 orders a day/ 3000 different items
- Cisco
 - A maximum of 24 hrs of lead time
 - Global customers
 - Little over one million units handled for 2001
- SGI
 - Large number - massive products
 - 7000 time critical parts every month



Kanban and JIT

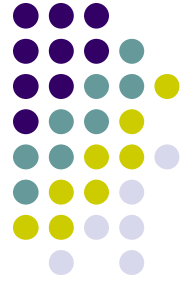
- Kanban
 - A tag or card that is tied to a part or product or WIP
 - Two types
 - Conveyance
 - Production
 - Aimed at reducing overall costs and making production more efficient
- Key is availability of information !



Traditional Data Sources

- Handwritten Reports (Kanbans)
- Manual Data Entries
- Computerized Data Entries
- Optical Code Readers
- Internet Connected Databases

Focus



Identification – Positioning – Data Extraction

Radio Frequency Communication



- Plain Vanilla Radio Transmission
- IEEE 802.11/b/g Wireless Transmission
- Bluetooth
- UWB
- Multi-Frequency RFID

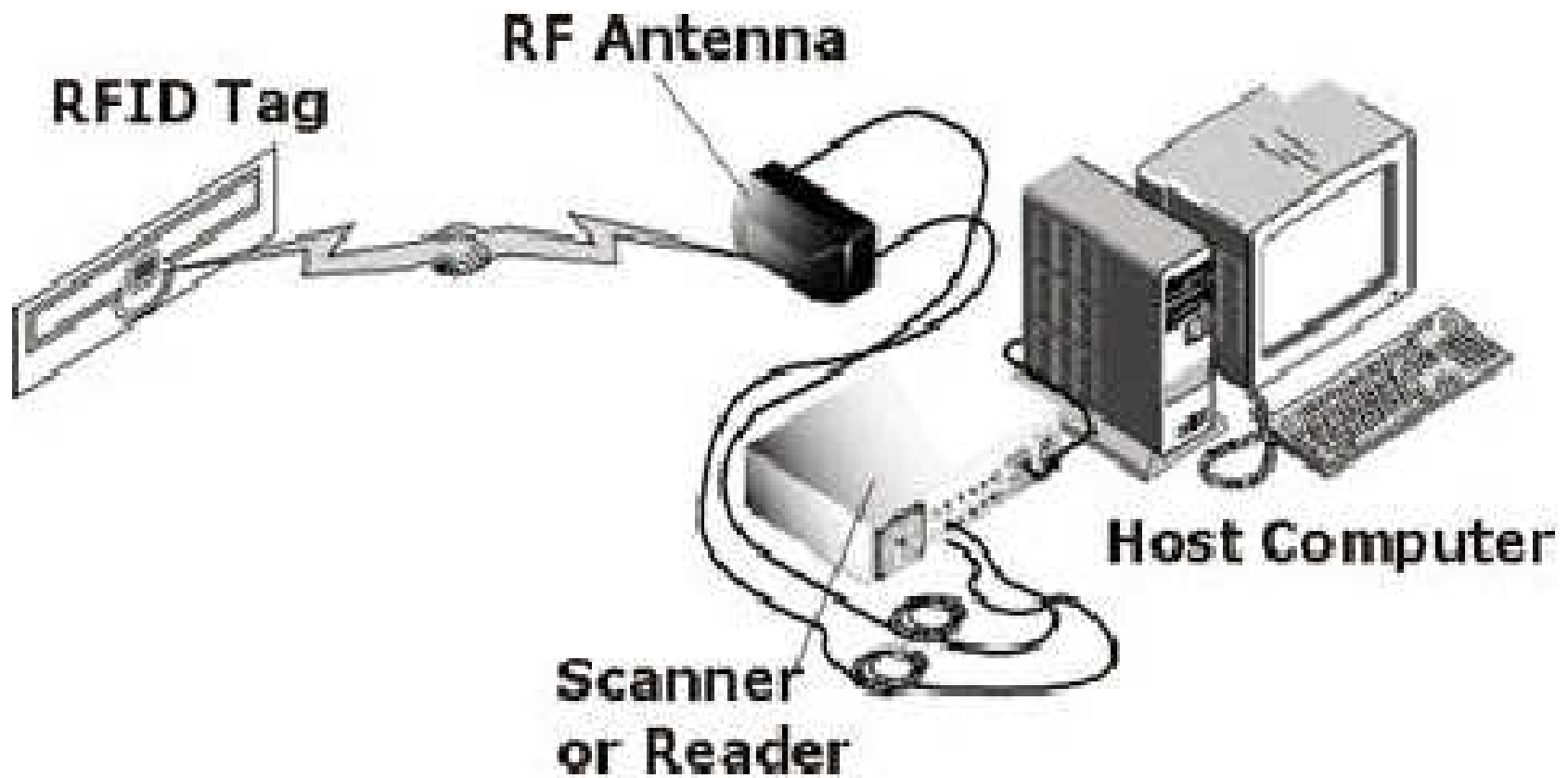
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RF ID - Introduction

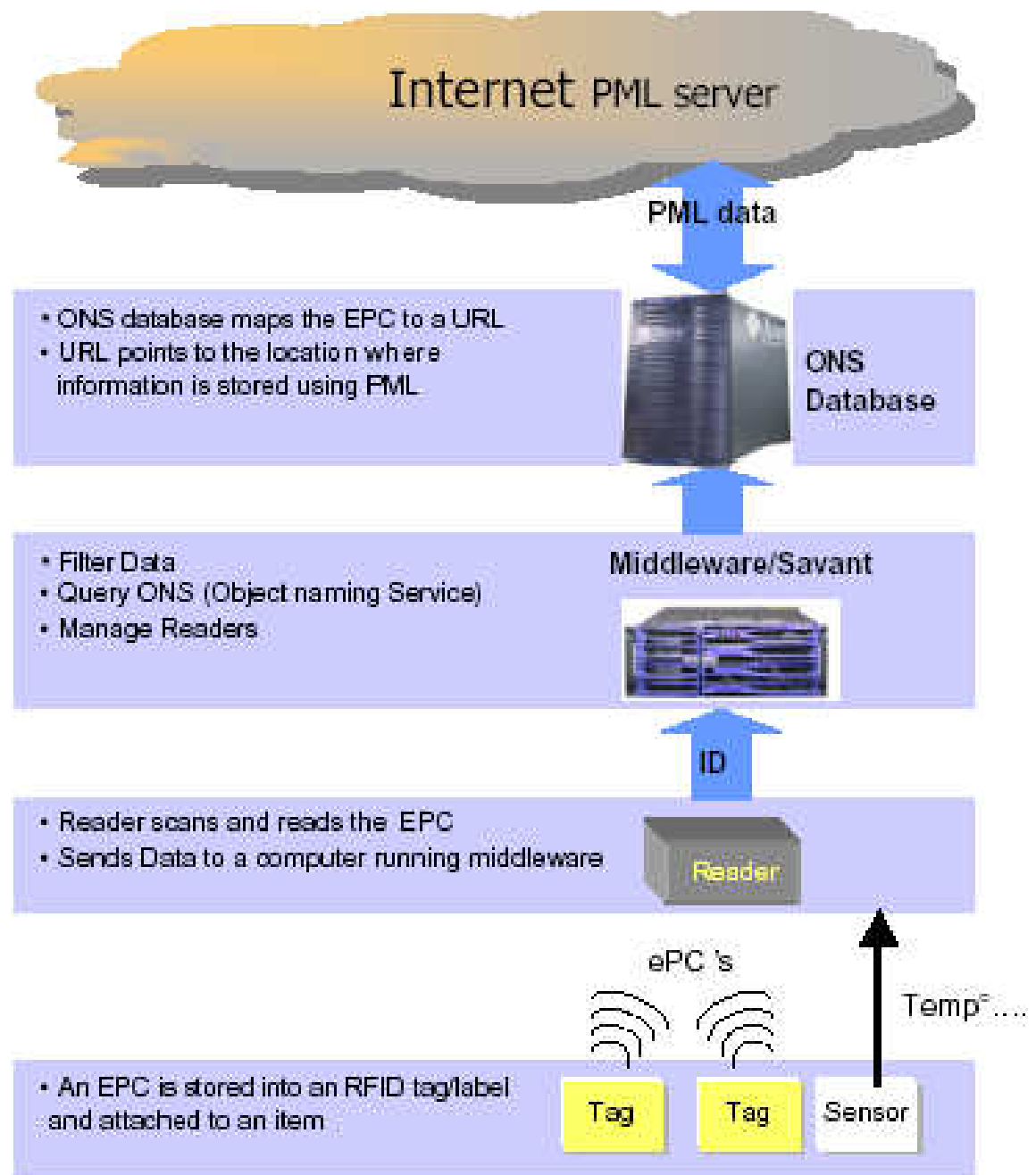


RFID is a means of storing and retrieving data through electromagnetic transmission to a RF compatible integrated circuit

Components



Framework





Standards

Standards are for :-

- Tag Classification – Class 0 – 4
- Communication Protocols (Air-Interface Protocol)
- Data Structuring/Storage
- ISO UHF and Gen 2
- Comm Frequencies :- 135 KHz (LF), 13.56/433 MHz (HF), 2.45 GHz & 930 MHz (UHF)
- Key Players :-
 - DoD, WalMart, EAN Intl, Gillette P&G, Auto-ID Center, ISO/EPCGlobal , American/European, Uniform Code Council etc.



Key Players

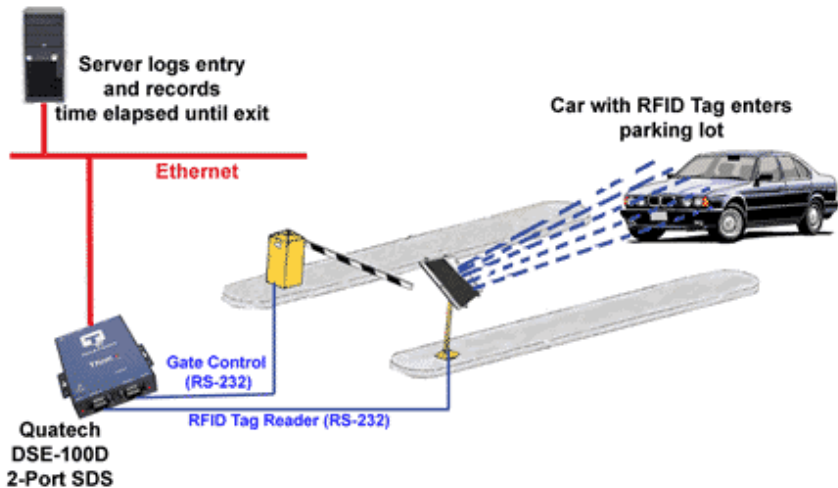
Product/Service	Companies
Chips	IBM, Hitachi, Philips, AMI, TagSys, RFSaw, Charterate
Inserts	International Paper, MeadWestvaco, Texas Instruments, Avery Dennison, SmartTag, Rafsec, Power Paper, LabID
Printers	Zebra, Printronix, Alien tech, Intermec, Toshiba
Tags	Alien Tech, Matrics, Intermec, Philips, TI, SAMSys, MeadWestvaco, Flint Ink, Hitachi, Siemens, Power Paper, Avery Dennison, TagSys, RFSaw, Savi, Rafsec, FlexChip, Omron, iPico, Identec, Amatech, Tyco, Wavetrend, LadID
Antenna	Flint Ink, Avery Dennison, Moore, EMS, Omron
Readers	Alien Tech, Intermec, Matrics, Symbol, TI, SAMSys, Hitachi, Checkpoint, Savi, TagSys, Rafsec, Wavetrend, Feig, Omron, Tyco, Moba, Siemens, InKode, Amatech, Identec, iPico
Data Aggregation, Filtering Systems	IBM, OATSystems, ConnectTerra
Middleware	IBM, Accenture, OATSystems, Microsoft, SAP, Oracle, Sun, Savi,

Identification and Data Extraction



- **Electronic Product Code (EPC)**
 - Globally unique serial number
 - Allows enquiries about a single instance of an item, wherever it is within the supply chain.
- **The ID System**
 - ID System = EPC tags + EPC readers.
- **EPC Components**
 - Header, identifies the length, type, structure, version and generation of EP
 - Manager Number, identifies the company
 - Object Class, similar to a stock keeping unit or SKU
 - Serial Number, information of specific instance of the Object Class being tagged

Applications



Control of Uniforms

- Uniforms can be automatically sorted by size, delivery destination, etc., by reading data input to the ID Tags.
- Detailed quality control can be performed by writing the number of cleaning times or repair history.



■ FIFO (first-in first-out) function

Collecting by Ticket Type at a Ski Resort

- The V700 System can be used for counting the number of skiers at a gate according to the type of ticket (one-day ticket, coupon ticket, etc.).



Mailbox Control

The V700 System can be used for individual control of mailboxes for an apartment building.



Sorting

Automatic sorting can be performed by reading the ID codes on ID Tags.



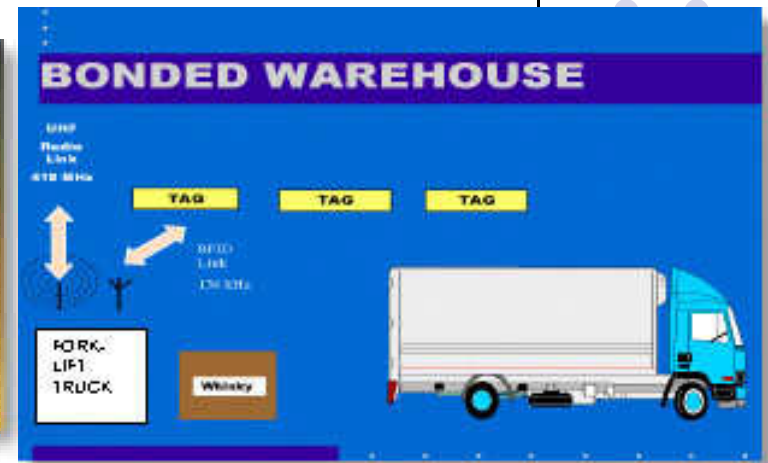
Cafeteria POS

By attaching ID Tags to dishes and imbedding price look-up data, the total price can be calculated automatically.



■ Simultaneous access to more than one Tag (1-N read/write)

Manufacturing



- Unilever + TI , Automated Pallet Handling
- Chevy + TI, Traffic Control of Pallets and Materials
- Food Processing Industry – Frozen foods
- Protection of Costly goods, RFID + TI, Protection of whiskey crates



Tags - Types

- Two Main Classification (Power Source)
 - Passive & Active
- Other Classifications are by
 - Operational Conditions (Hot, Cold, Outdoor/Indoor)
 - Material – Wood/Metal/Liquid
 - Read Rate
 - Tag Density in ambient environment
 - Read Distance
 - Dual/Dipole Antenna
 - Energy Source - Induction/BackScatter/Battery
 - Opnl Freq – HF/LF/UHF/Microwave
 - Standards – EPC/ISO
 - Reader Support
 - Tag/Label – Card, Disc, Coin or Label
 - Communication Mode - Ampl/Freq/PWM/Phase
 - Class – 0 -> 4



Tags – Passive and Active

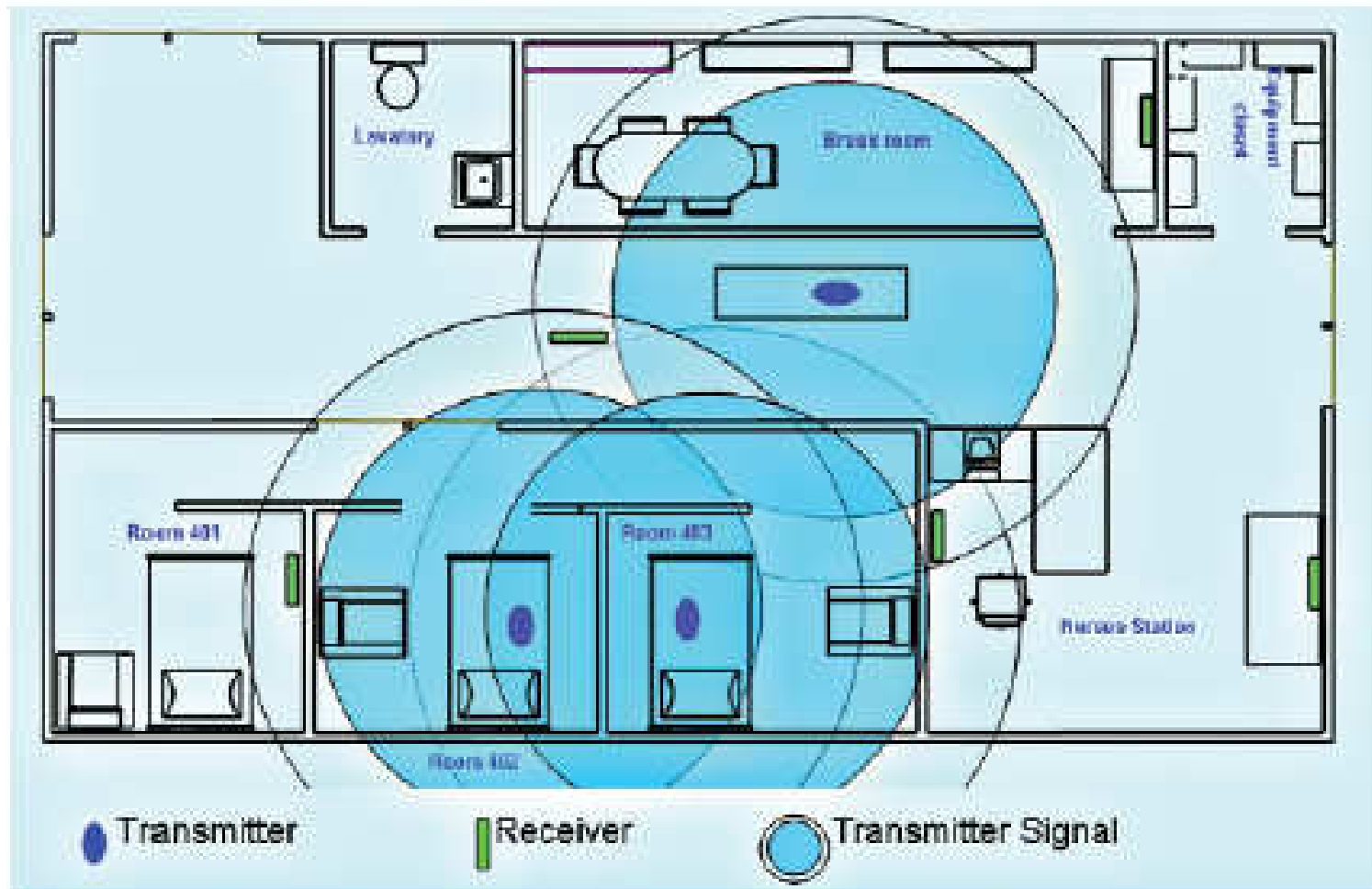
- Passive
 - Induction/Backscatter
 - Class 0-2
- Active
 - Transponders/Beacons – Range (<300 ft)
 - Class 3 and 4

Readers



- Classified based on
 - Range
 - Fixed - Handheld
 - Read - Write
 - Reading Rate
 - DSP Capabilities
 - Frequency of Operation
 - Cost
 - Antenna
 - Packaging
 - Anti-Collision
 - SDK

Positioning Systems – RFID

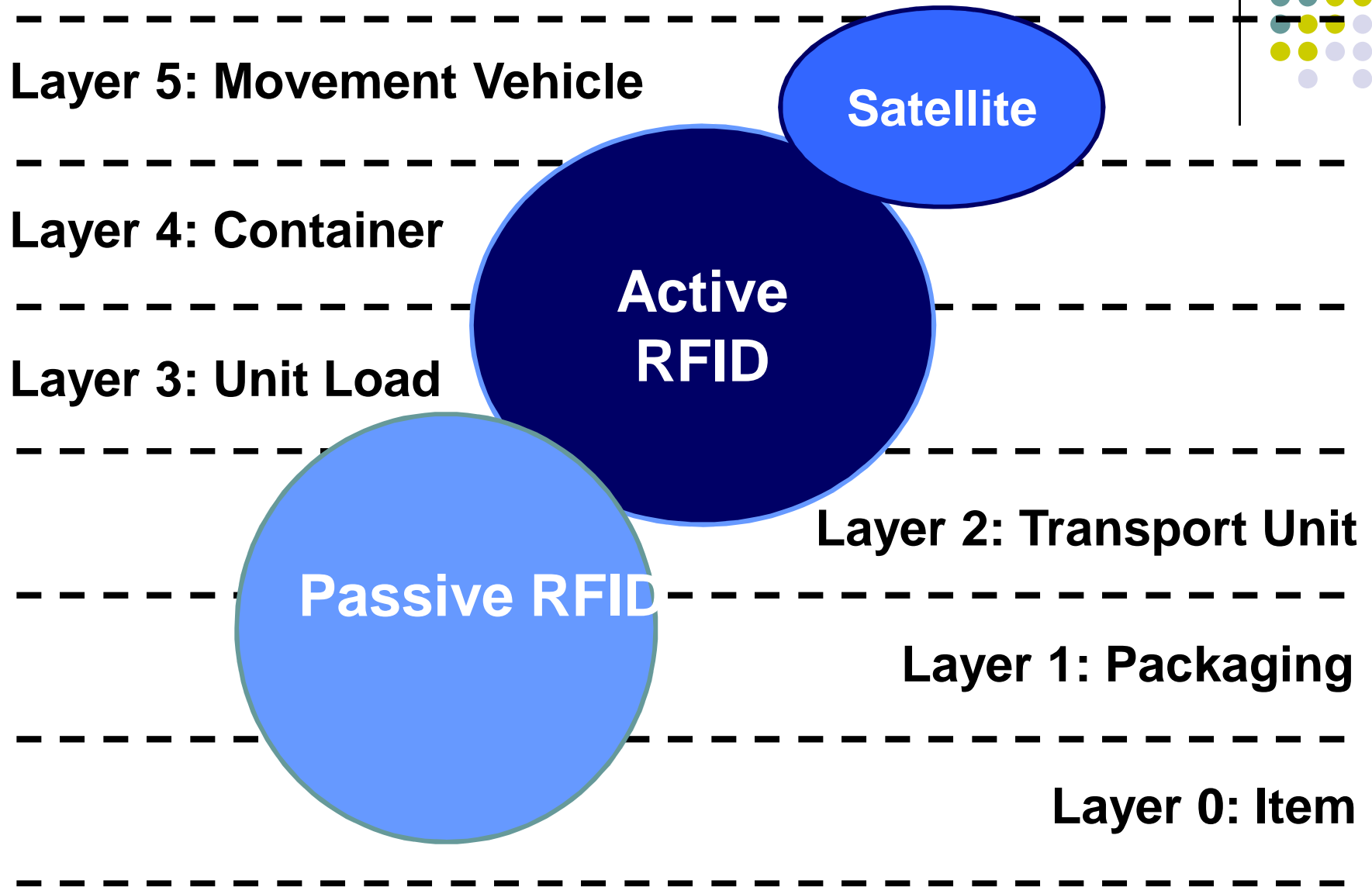
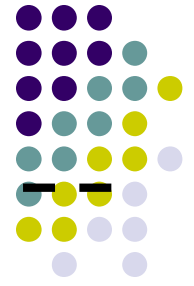


RTLS – LPS – LLS – LPR

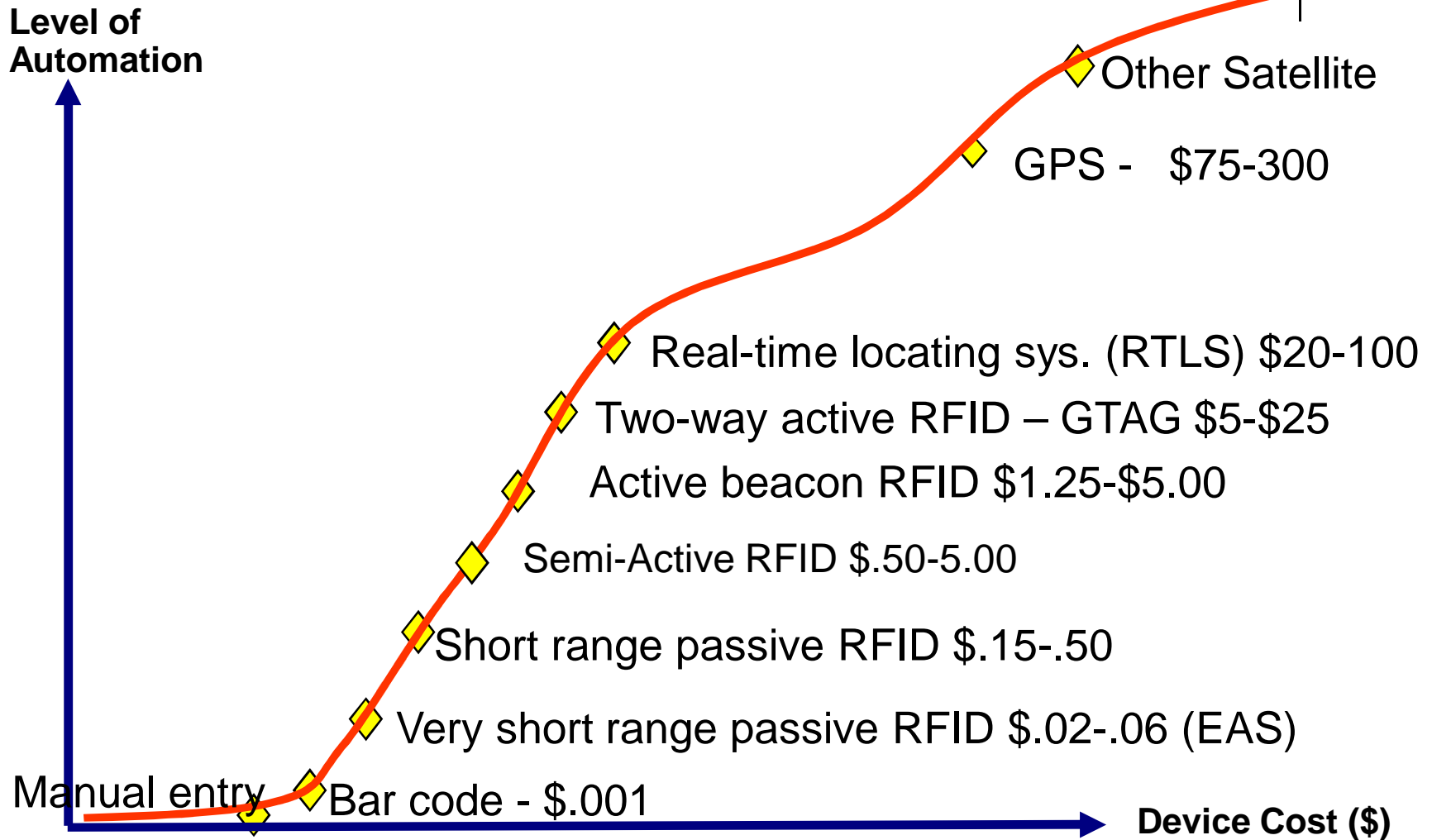


- Time of Flight
- Attenuation
- Detection
- Triangulation
- Indoor Radar – Backscatter

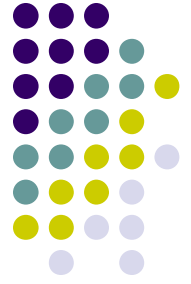
Current RFID Hierarchy



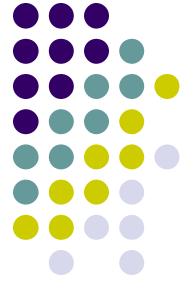
Cost Projections for RTLS



Good



- Automation.
- No line of sight requirement.
- Withstand a harsh environment.
- Long read range.
- Portable database
- Multiple tag read/write.
- Tracking people, items, and equipment in realtime
- Additional information storage



Bad

- High cost
- Problems with RF technology (attenuation etc)
- Invasion of privacy

Ugly



Question or Comments ?