How to Bring Things Together to the Smart Warehouse?

Jinghua Gao, Zhi Chang(Lenovo Research)
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Lenovo 联想

Agenda

01   State of the Industry

02   Warehouse Solution

03   Whitsett Solution

04   Demo

05   Summary

Lenovo

1. State of the Industry

Warehouse Need to be Smarter

Warehouse Management Tenets

Products
Increase with an exponential rate

Warehouse

– Redundant Processes
– Poor Facility Layout
– High Labor Costs & Time consuming 65%
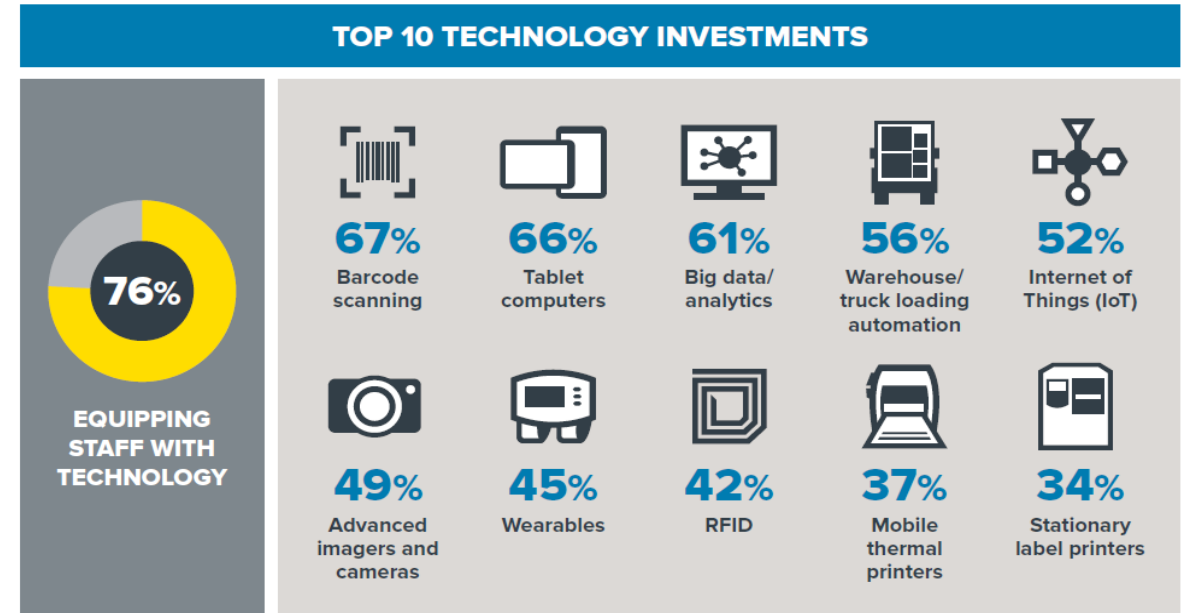– Inaccurate Inventory

accuracy

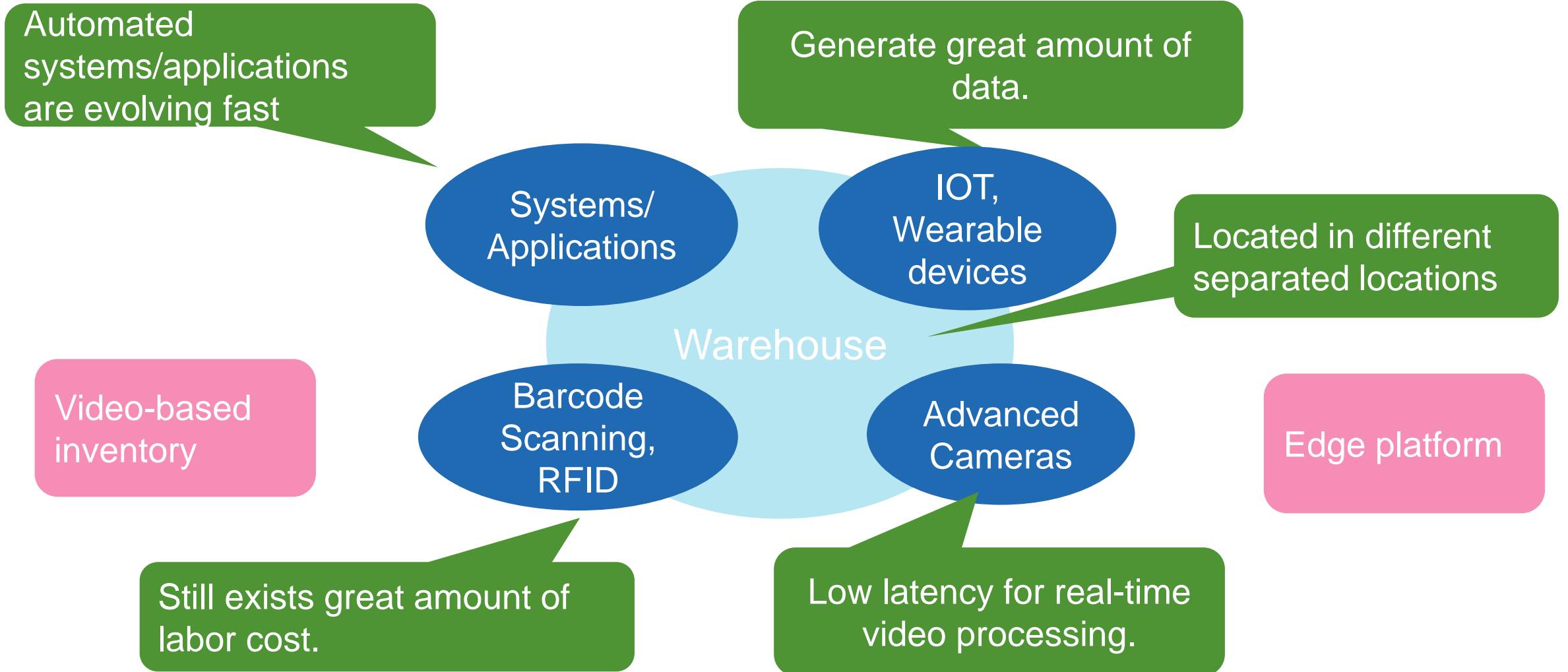cost

efficiency

Days/Hours

Customers
Immediate gratification

Emerging Technologies Revolutionize Warehouse

- IOT, RFID, Barcode Scanning
  - Provide the free flow of real-time data.
  - Have real time visibility of the location.
  - Provide Accurate inventory.

- Wearable
  - Free up warehouse workers to move anywhere.

- Truck Automation
  - Reduce heavy work.

- Advanced Cameras
  - Provide surveillance
  - Real-time detection/analytics

TOP 10 TECHNOLOGY INVESTMENTS

76%
EQUIPPING STAFF WITH TECHNOLOGY

67% Barcode scanning	66% Tablet computers	61% Big data/ analytics	56% Warehouse/ truck loading automation	52% Internet of Things (IoT)
49% Advanced imagers and cameras	45% Wearables	42% RFID	37% Mobile thermal printers	34% Stationary label printers

Challenges

Automated systems/applications are evolving fast

Generate great amount of data.

Systems/Applications

IOT, Wearable devices

Located in different separated locations

Warehouse

Video-based inventory

Barcode Scanning, RFID

Advanced Cameras

Edge platform

Still exists great amount of labor cost.

Low latency for real-time video processing.

2. Smart Warehouse Solution

Efficiency Accuracy, Low Cost

Features

Accuracy

Real-time monitoring

Abnormal events alerting (pallet drop, overturn ..)

Goods classification and arrangement(with SAP)

Efficiency

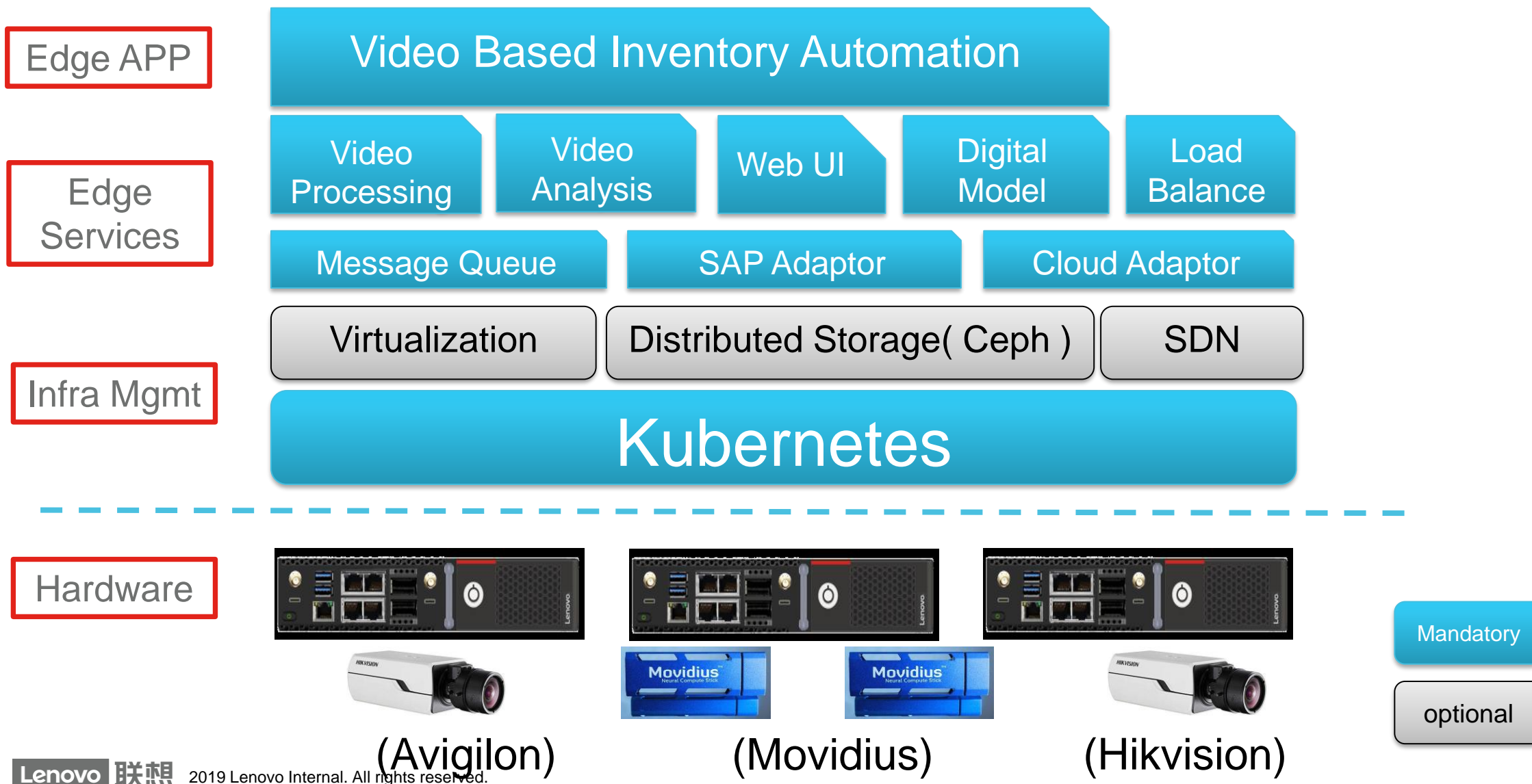Forklift navigation

Statistics utilization of warehouse resources
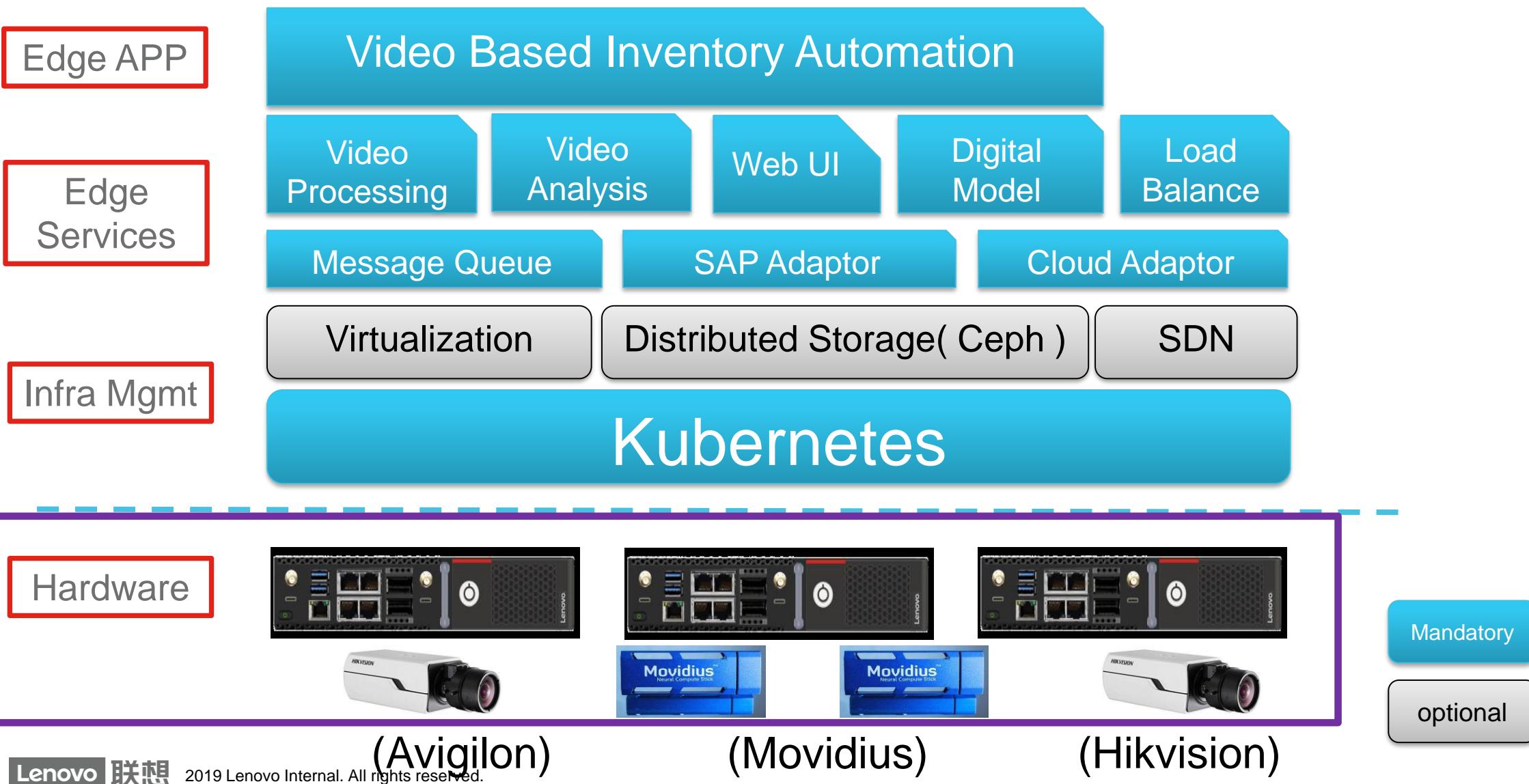
Historical tasks analysis

Low Cost

Video-based inventory
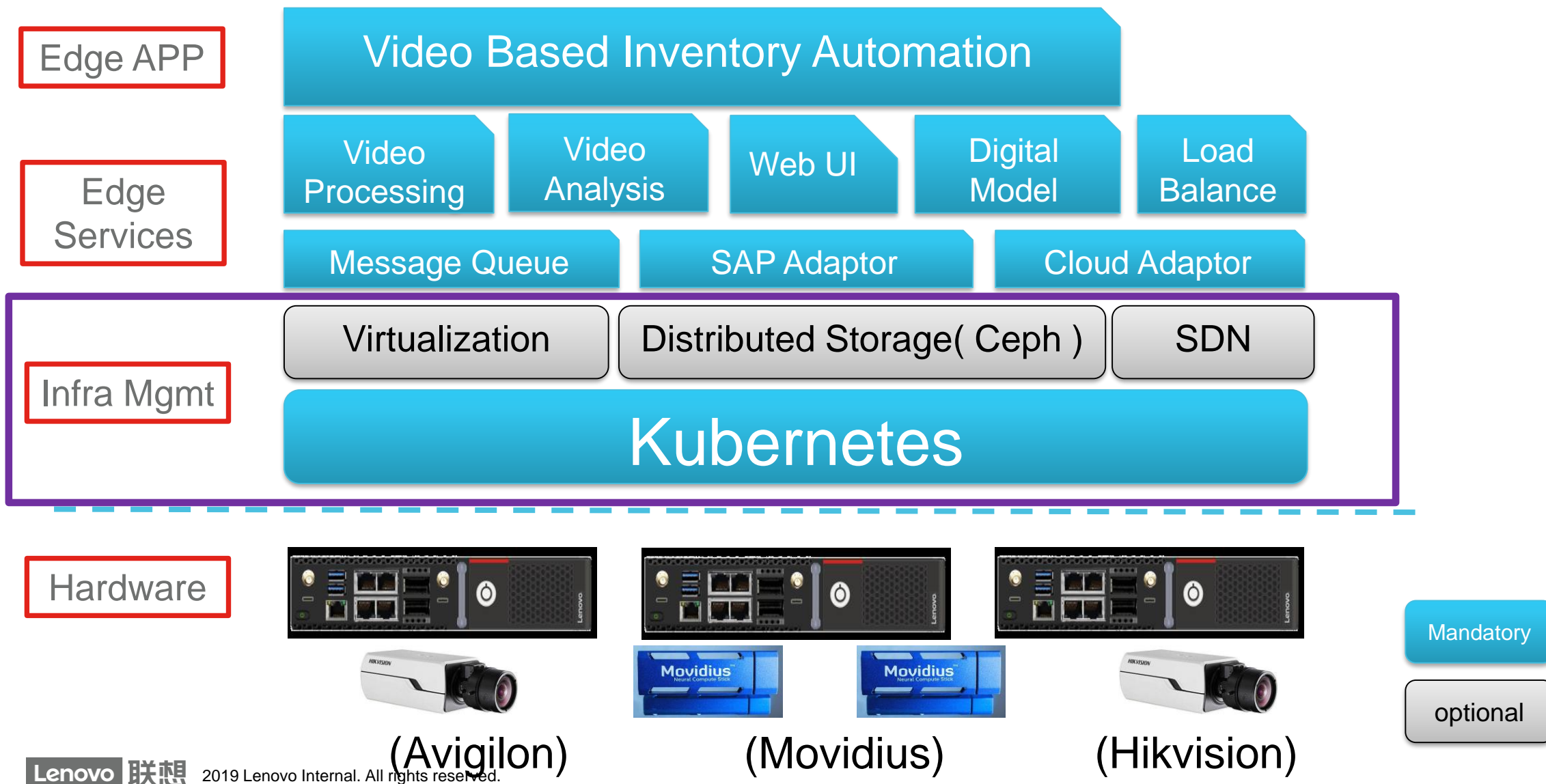
Smart Warehouse Edge Platform Overview

Edge APP

Edge Services

Infra Mgmt

Hardware

Video Based Inventory Automation

Video Processing

Video Analysis

Web UI

Digital Model

Load Balance

Message Queue

SAP Adaptor

Cloud Adaptor

Virtualization

Distributed Storage(Ceph)

SDN

Kubernetes

(Avigilon)

(Movidius)

(Hikvision)

Mandatory

optional

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Video Based Inventory Automation Design

- Warehouse Digitization:
  - Dmcode / Qrcode detection
  - PalletID / ForkliftID / LaneID Recognition
  - Position / Path / Status
  - Task / Record
- Processing Automation:
  - Receiving / Classification / Shipping
- Operation Intelligence:
  - Goods Arrangement
  - Forklift Navigation
  - Exception Handling
  - Processing Optimization

Video Based Inventory Automation Design
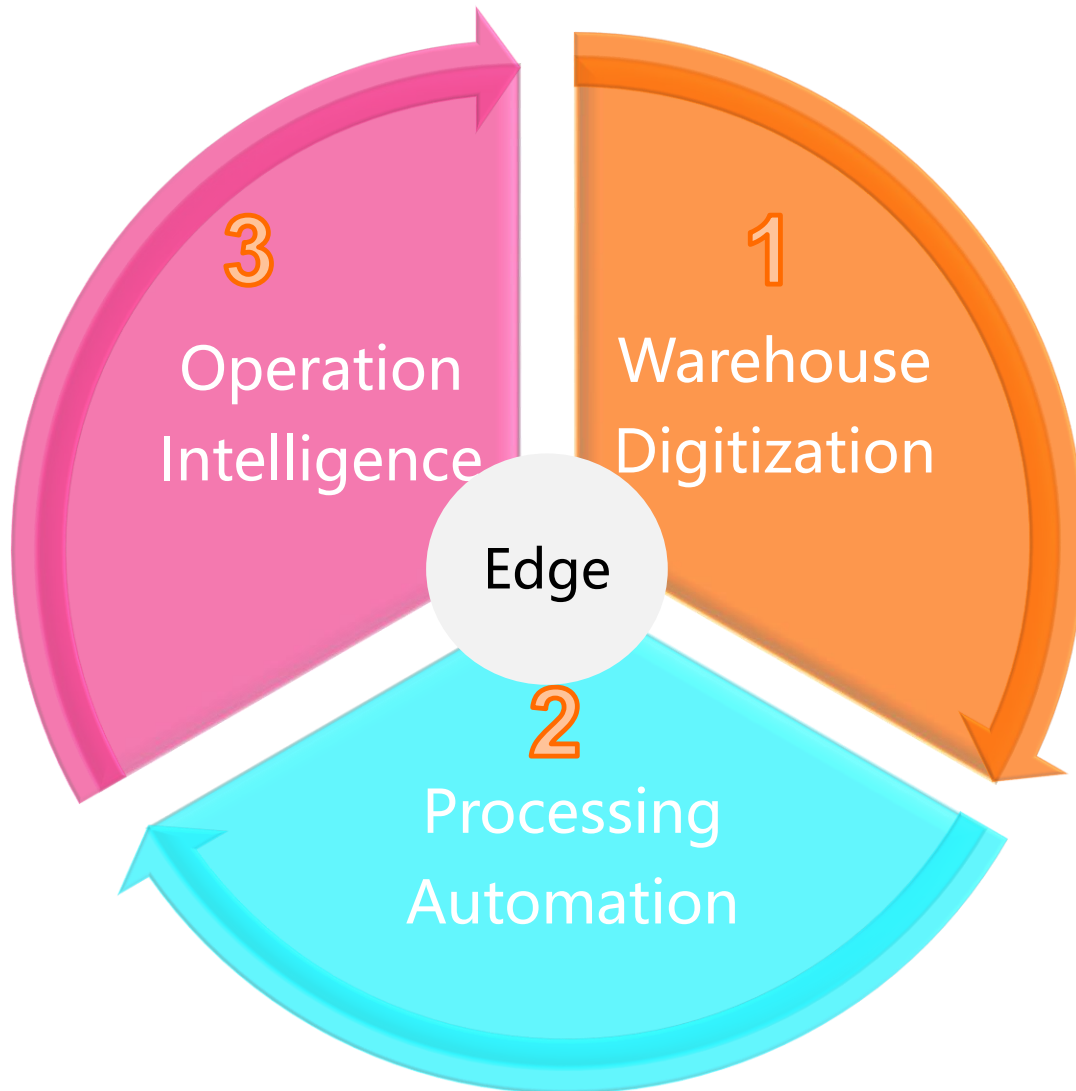
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Edge Service —— Digital Model

- Logic class and Entity class
  - Logic classes: Event, Scheduler, Task and Job
  - Entity classes: Vendor, Customer, Goods, Pallet, Forklift, Lane, etc.

Edge Service —— Message Queue
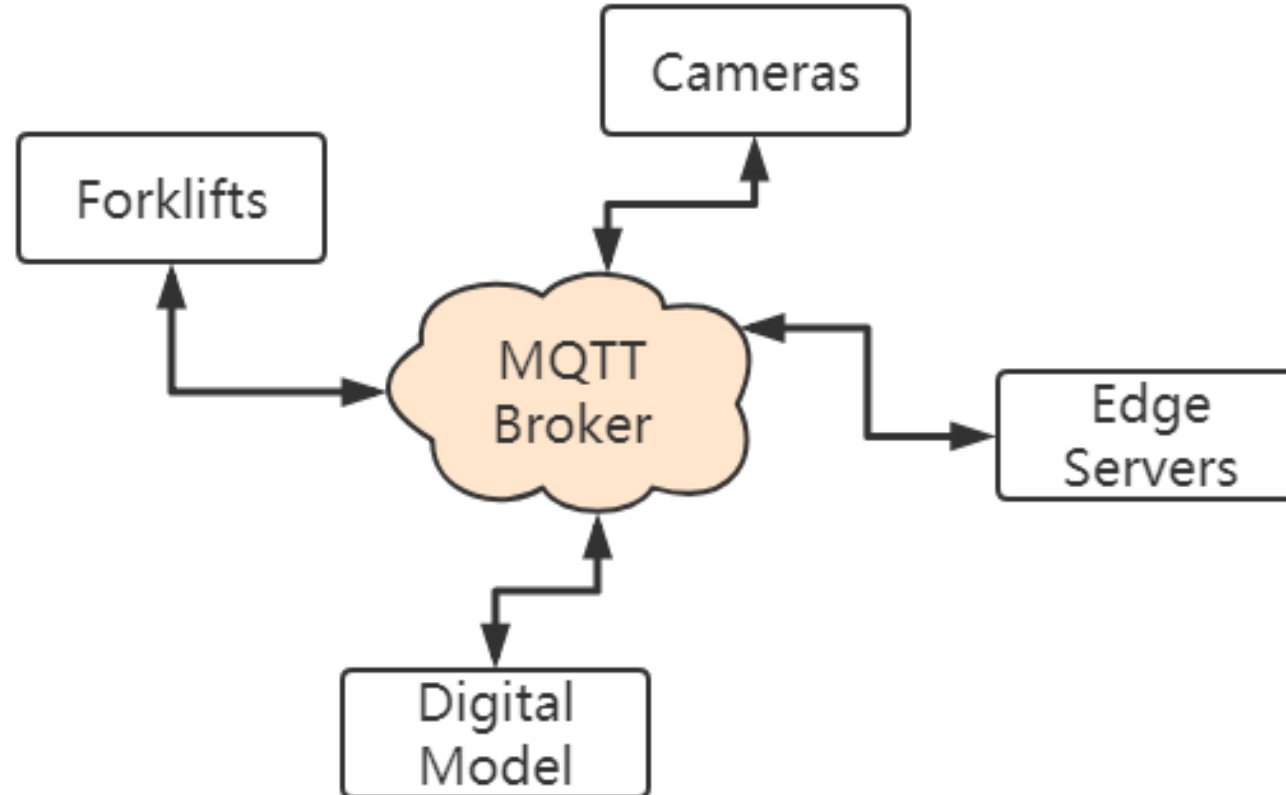
Edge Service —— SAP Adapter

- Adapt different SAP systems

- Keep data consistency (sync non-confidential data from SAP systems)

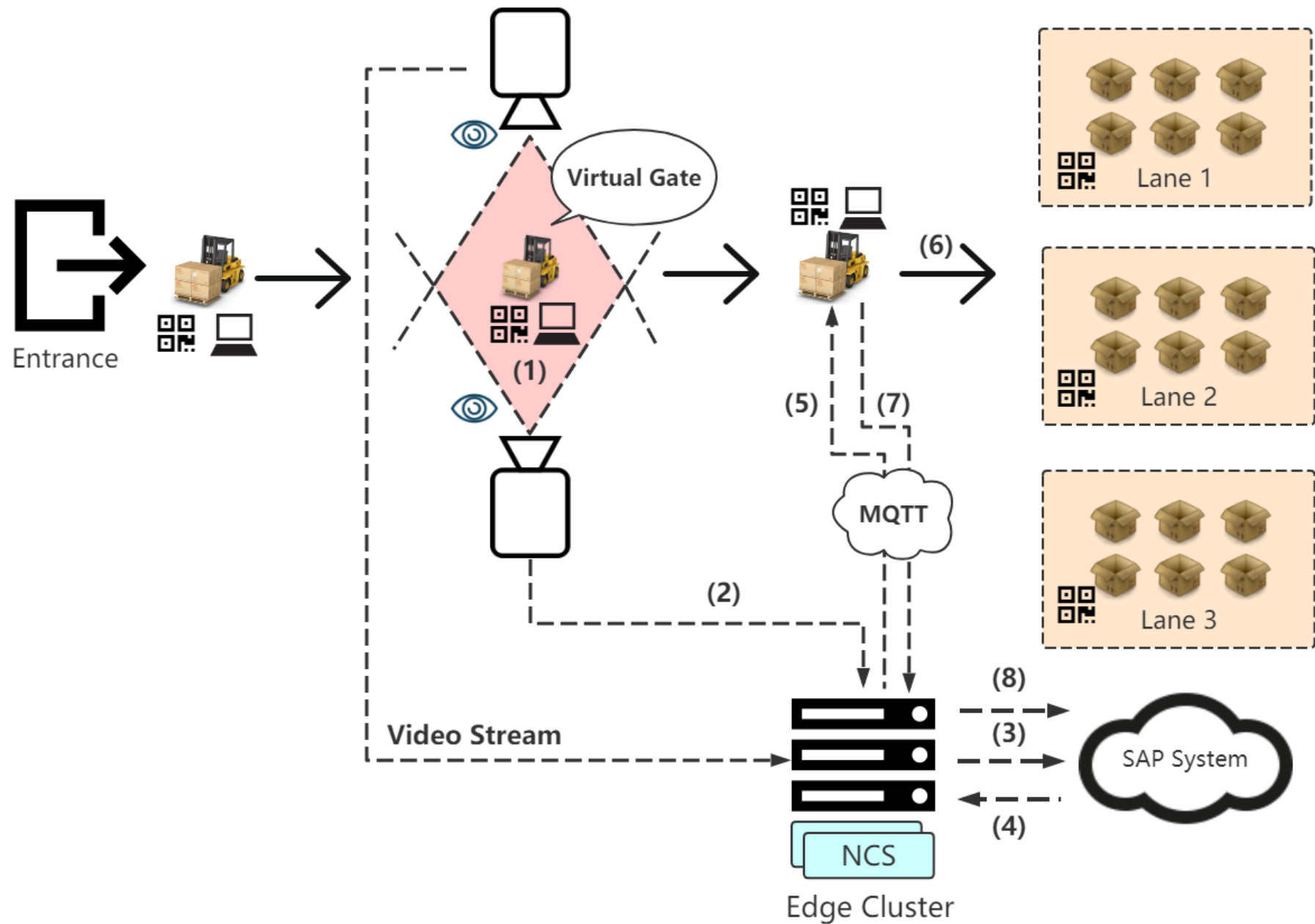- Monitor SAP systems and keep SAP systems available
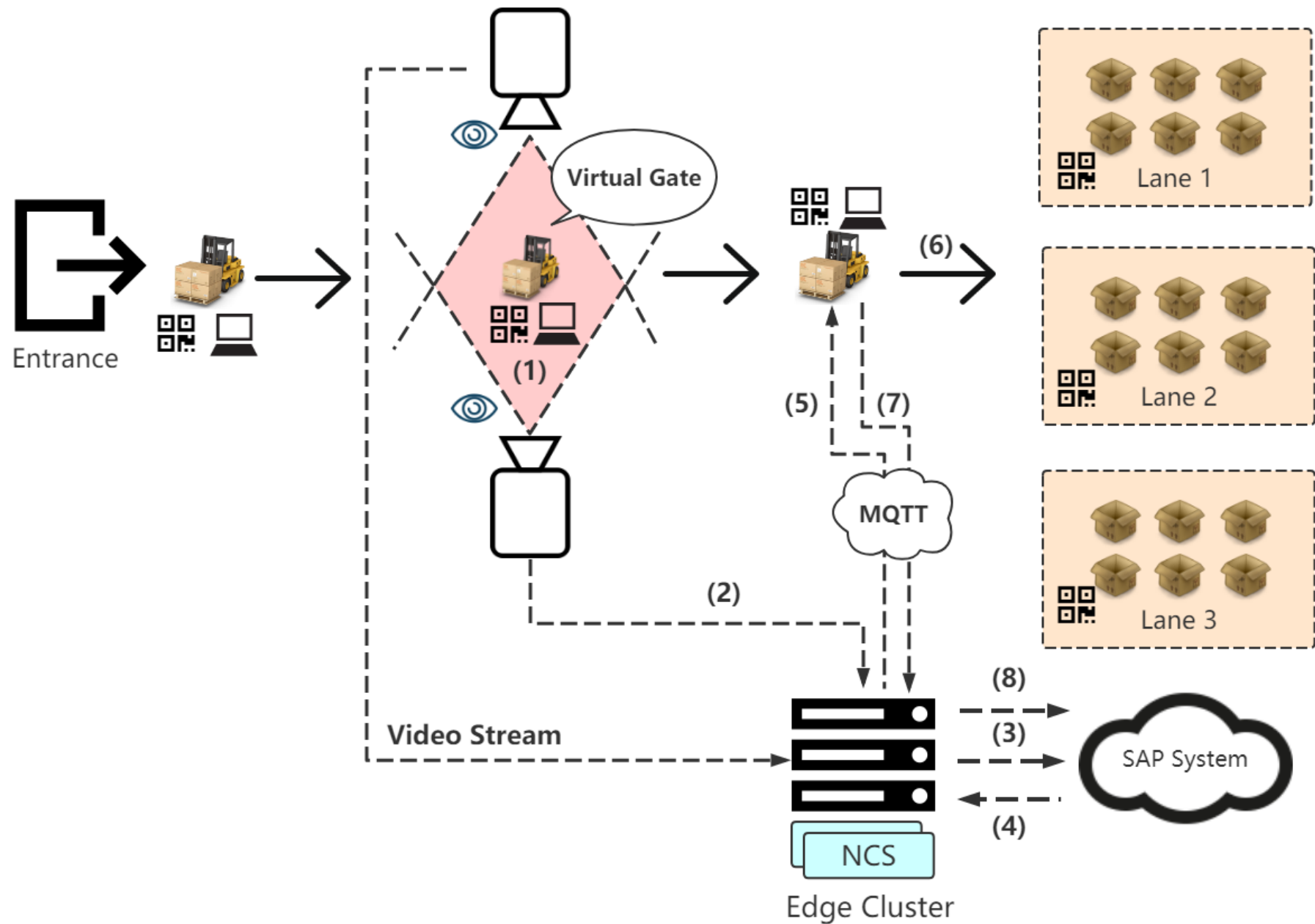
Edge Service —— Cloud adapter
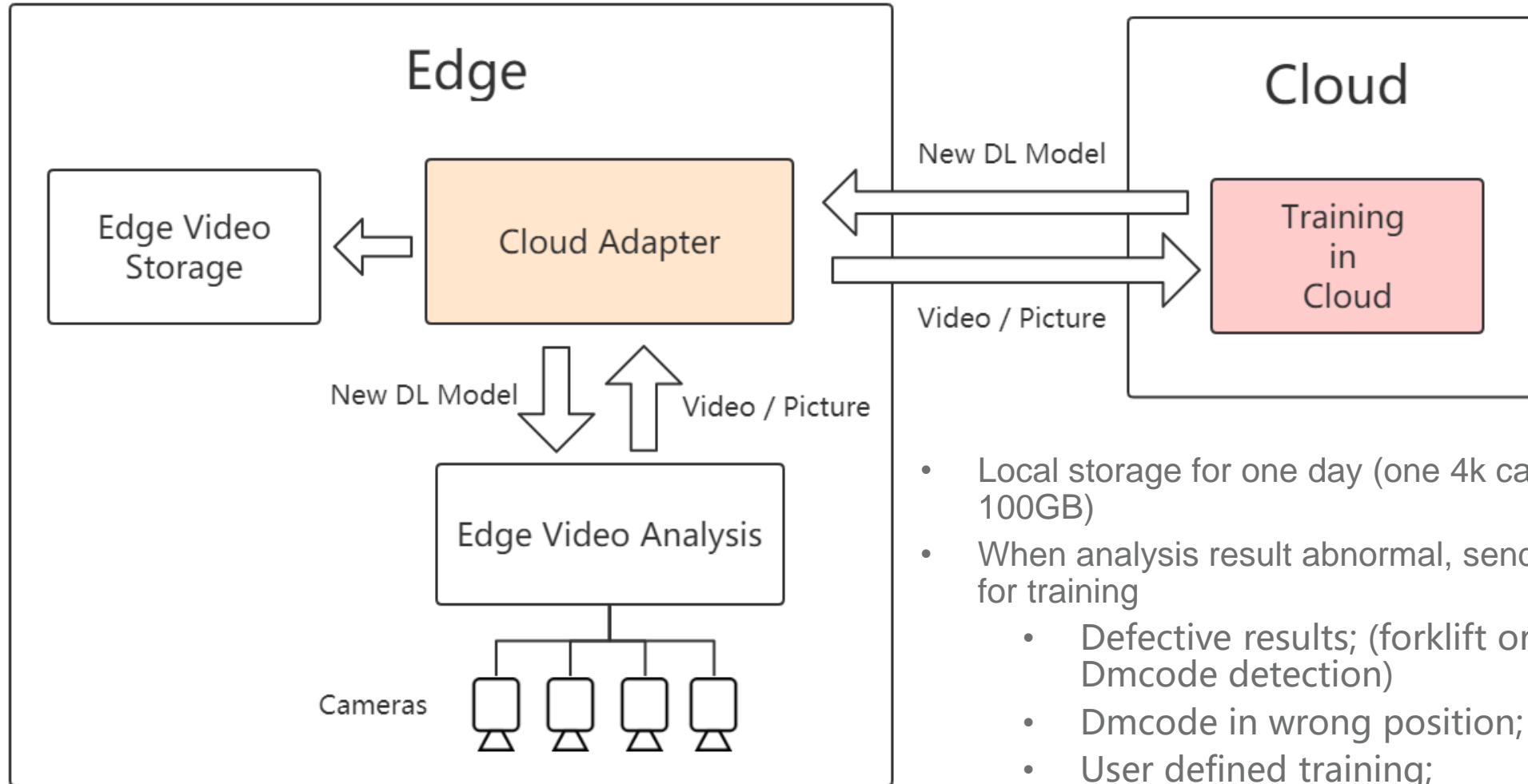
- Local storage for one day (one 4k camera 8 hour = 100GB)
- When analysis result abnormal, send videos to Cloud for training
  - Defective results; (forklift or pallet without Dmcode detection)
  - Dmcode in wrong position;
  - User defined training;

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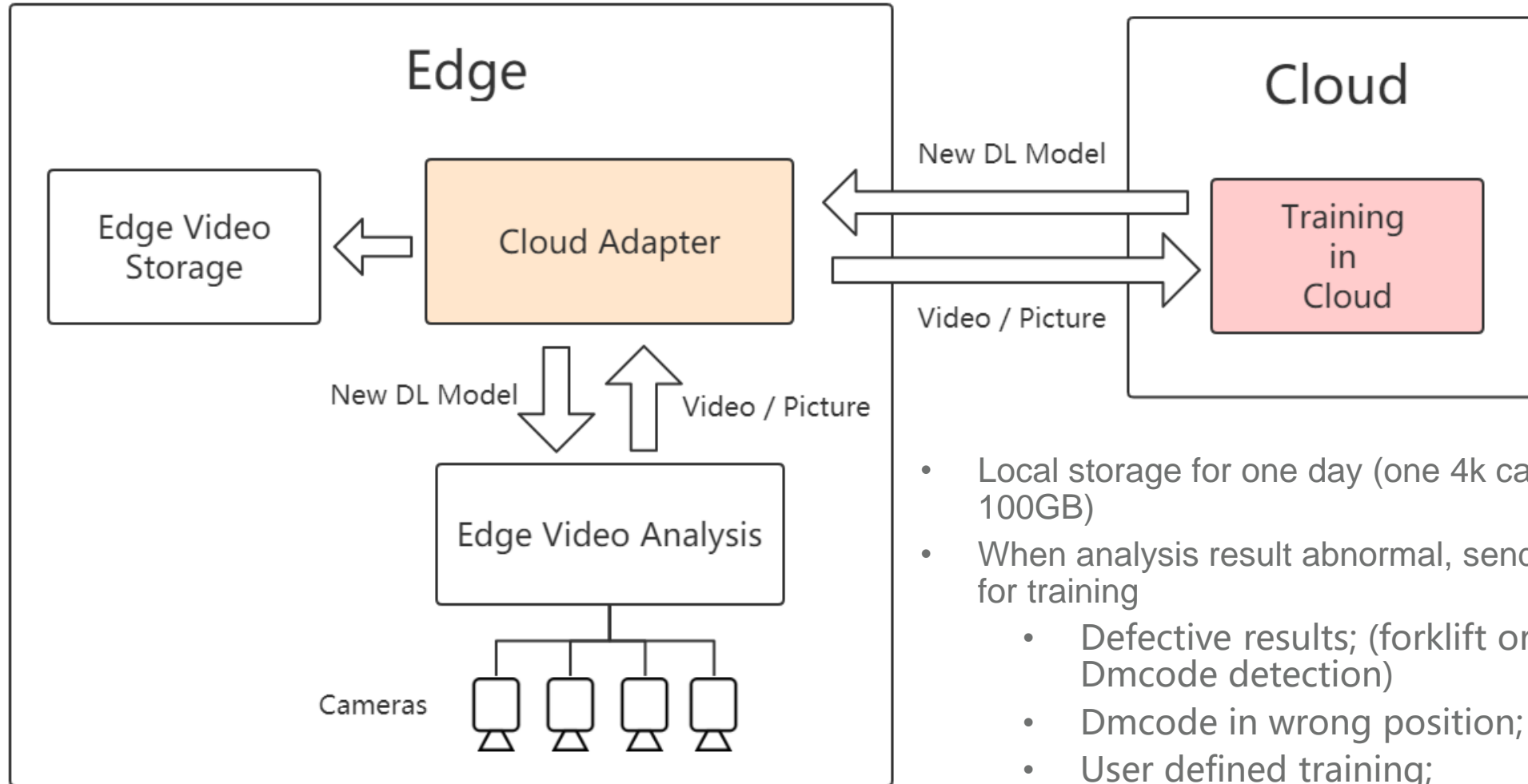
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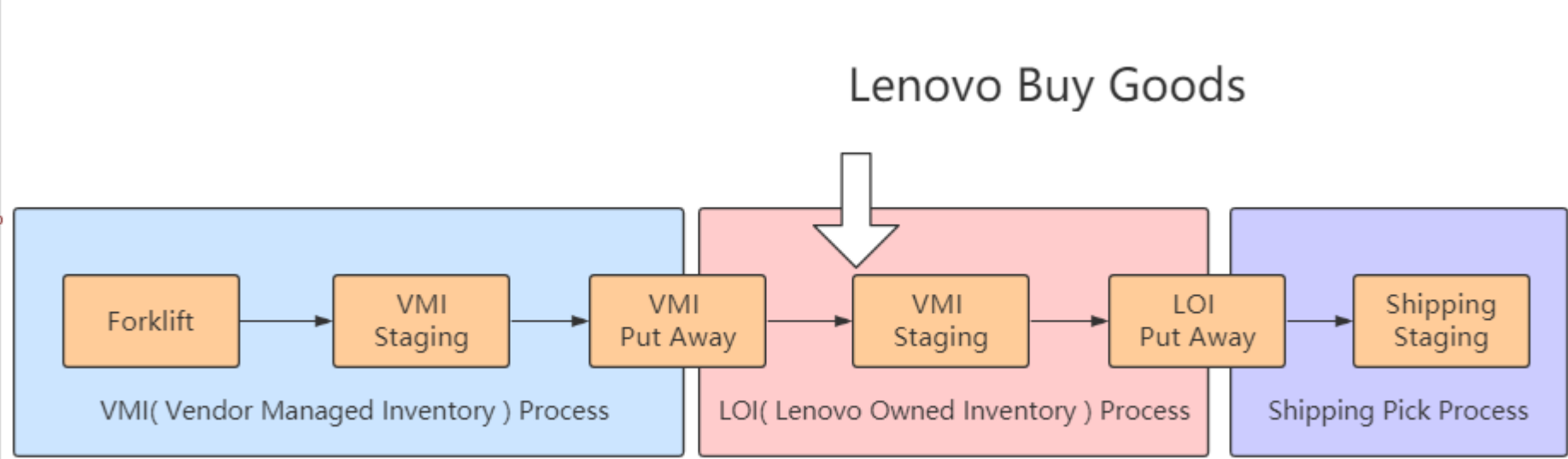 - User defined training;

3. Whitsett Warehouse Solution

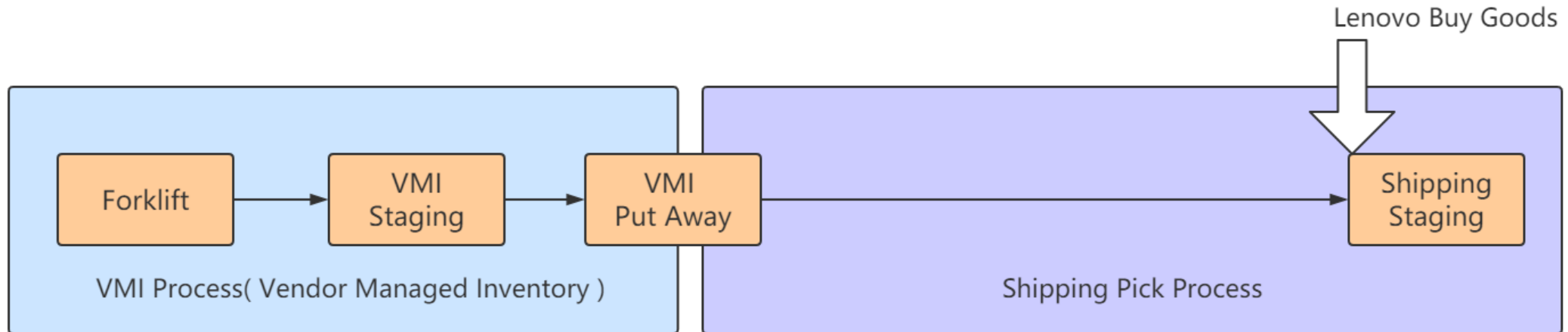# Whitsett Workflow

Whitsett Workflow

Old Process

New Process

Lenovo Buy Goods

| Forklift | → | VMI Staging | → | VMI Put Away | → | Shipping Staging |

VMI Process(Vendor Managed Inventory)

Shipping Pick Process

4. Video Demo

Whitsett Warehouse

Anticipated Business Results

- Reduces manual touch and 50% of the VMI freight movement

- Reduces the inventory carrying cost 90%, from 3days+ to hours

- Eliminate (estimated 20+%) of space requirements

5. Summary

Best Practices

- Start small and build a scalable solution.

- Platform is important to bring technologies together.

- Data is important for inventory and further optimization.
    - Refine processes, streamline operations and improve forecast accuracy.

Future work

- Improve the accuracy of video-based inventory for the barcode.

- Combine indoor navigation with automated guided vehicles.

- Implement our solution in Lenovo, HuiYang warehouse.

Q&A

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thanks.

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