

# ***Latest Automated Storage & Retrieval System (AS/RS) Technology – Two Cranes, One Aisle***

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Presented by:

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# Dual Mini Load

Two Cranes / One Aisle

Dual Mini Load AS/RS



# Topics Covered

Mini Load – What is the Load?

Typical Mini Load Automation

- Crane in Aisle
- Shuttle
- Dual

Dual Mini Load

Sequencing

Kitting

Summary

## Cartons



Can store end  
down aisle



Can even work  
with good cartons



Can store side  
down aisle

# Loads

## Totes



Corrugated  
Carton  
used as  
Tote



Corrugated  
Plastic  
Tote

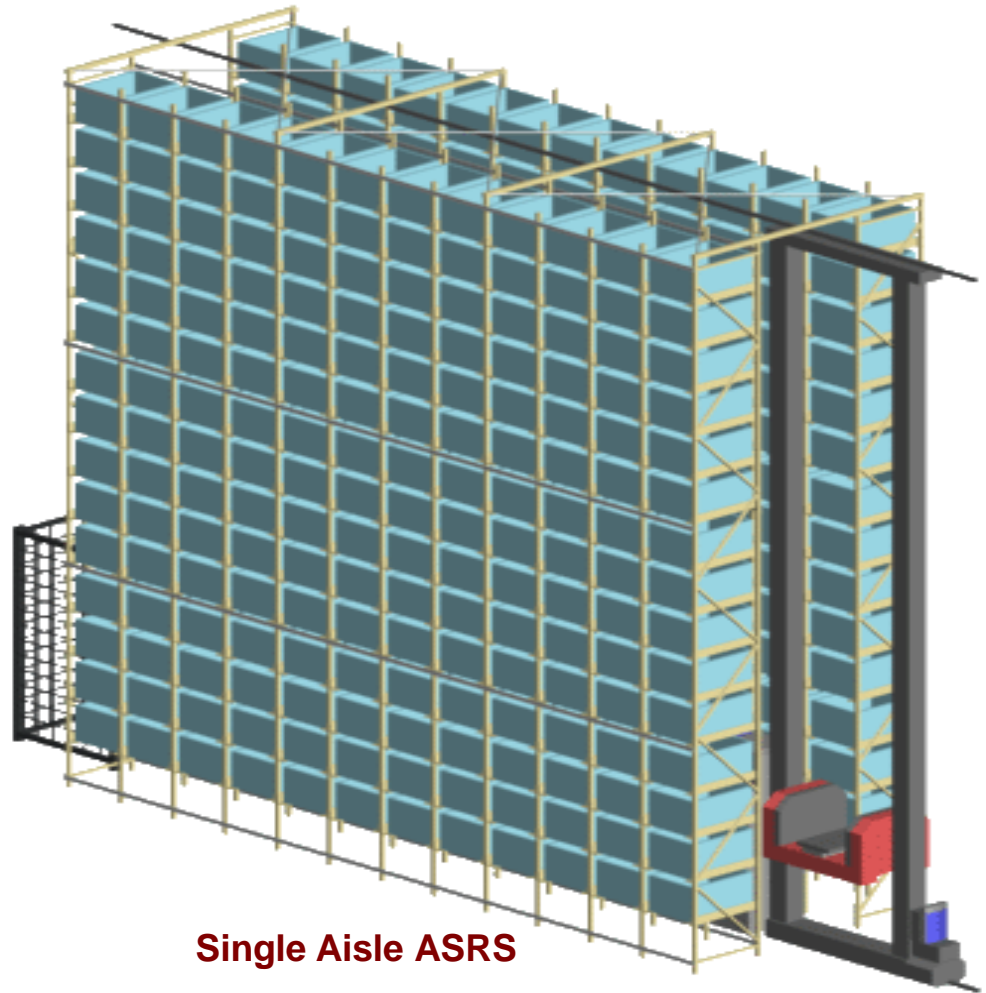


ESD  
Plastic  
Tote

# Crane in Aisle Mini Load



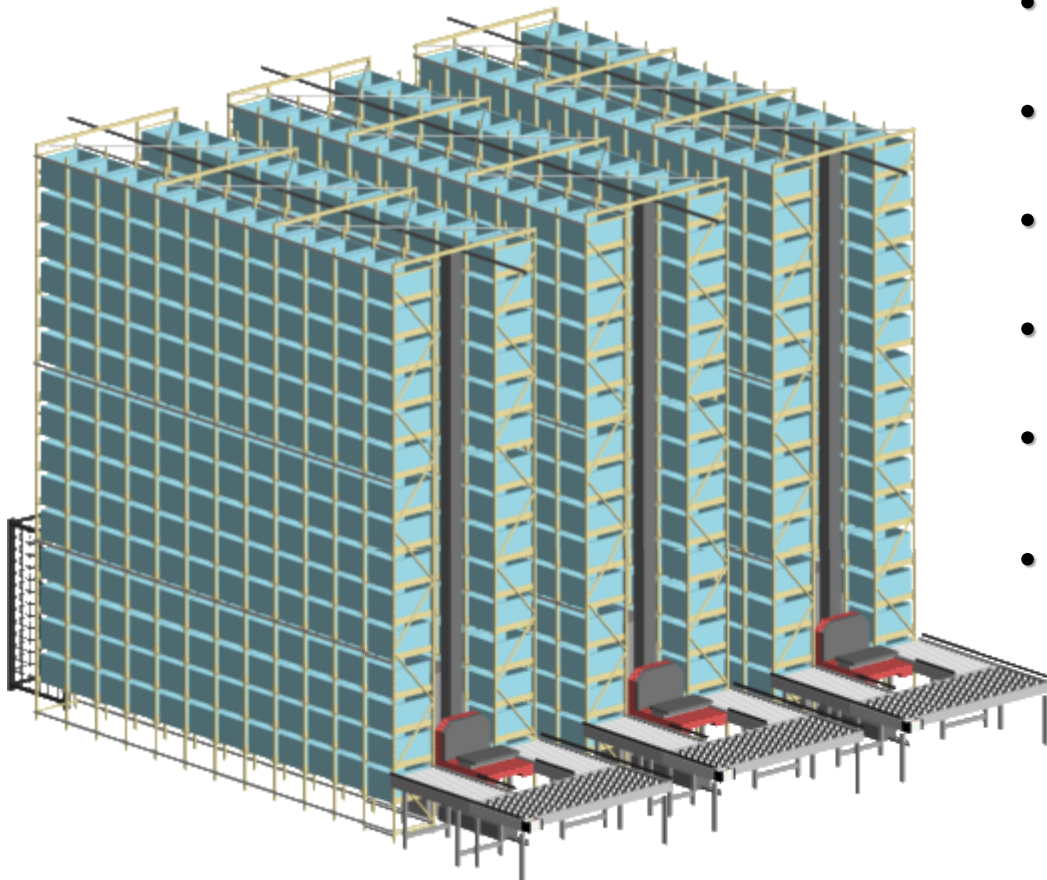
**Storage Retrieval Machine (SRM)**



**Single Aisle ASRS**

# Crane in Aisle Mini Load

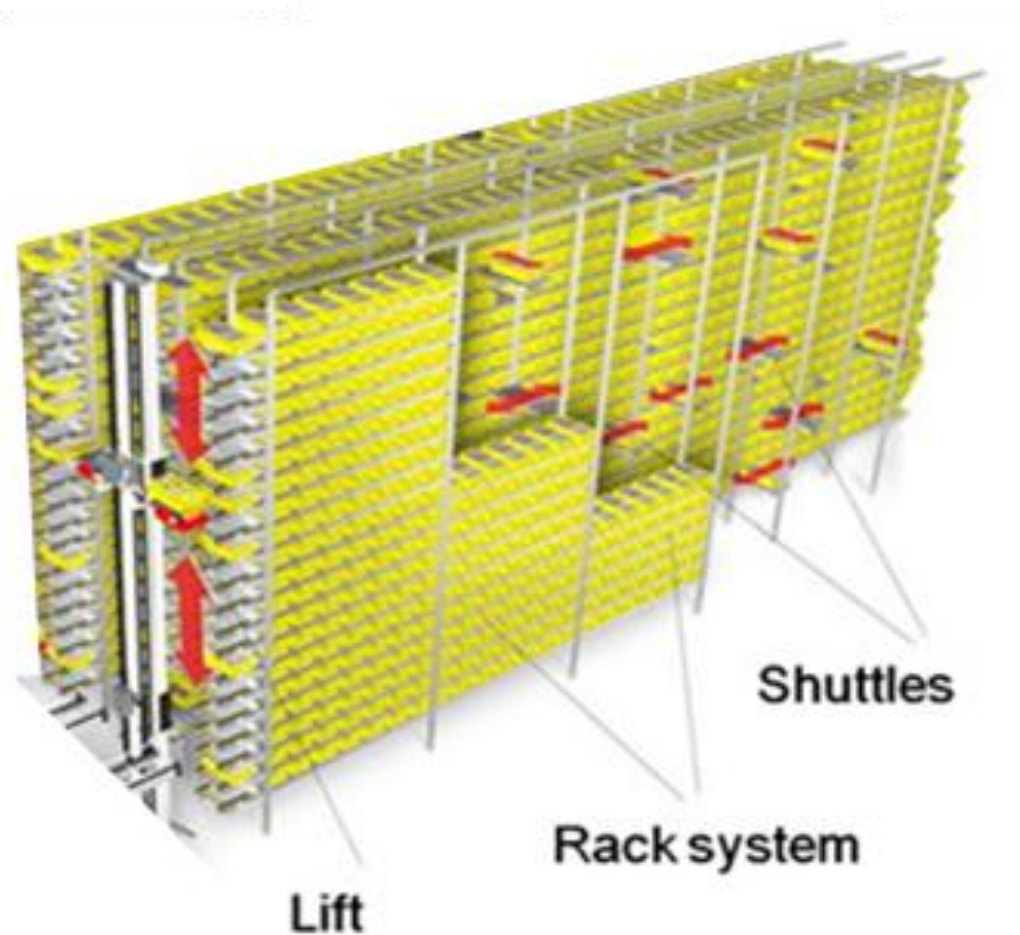
## Mini-Load AS/RS



- **Load weight capacity:**  
220 lbs.
- **Machine height:**  
33 ft.
- **Horizontal speed:**  
650 ft./min.
- **Vertical speed:**  
260 / 330 ft./min. Full / MT
- **2 extractors per machine**
- **Side belt extractors**

**Proven Technology  
1000s of installations**

# Shuttle Type Mini Load

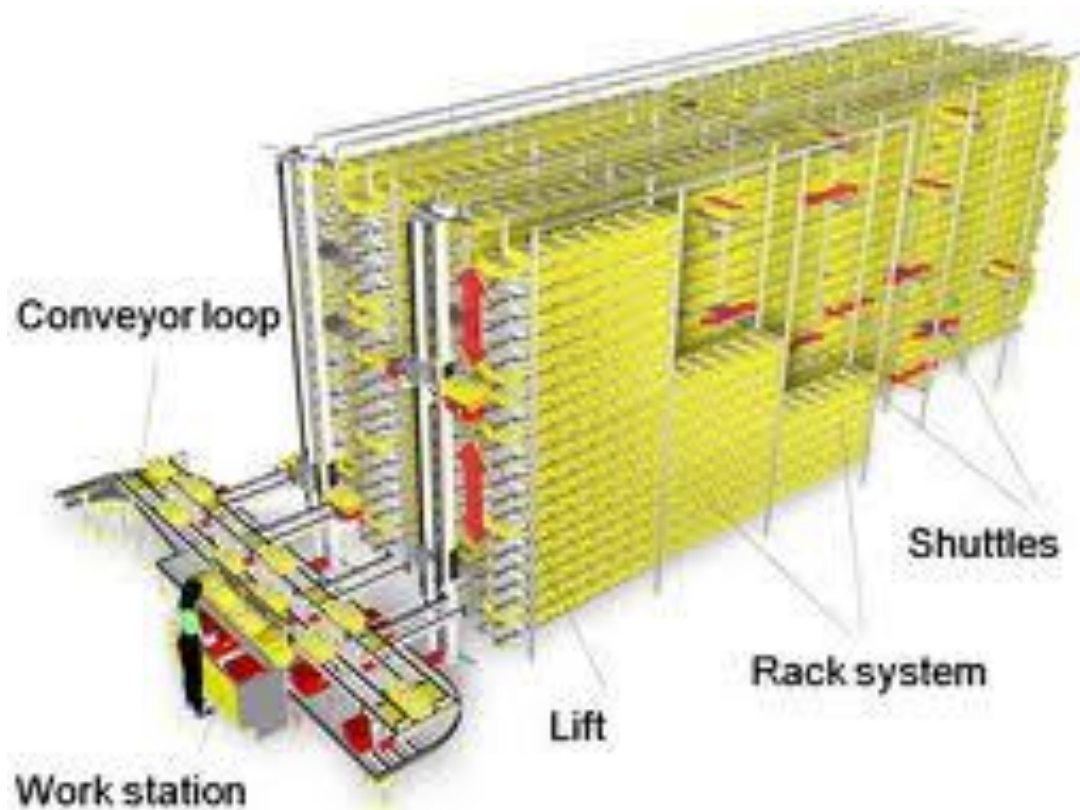




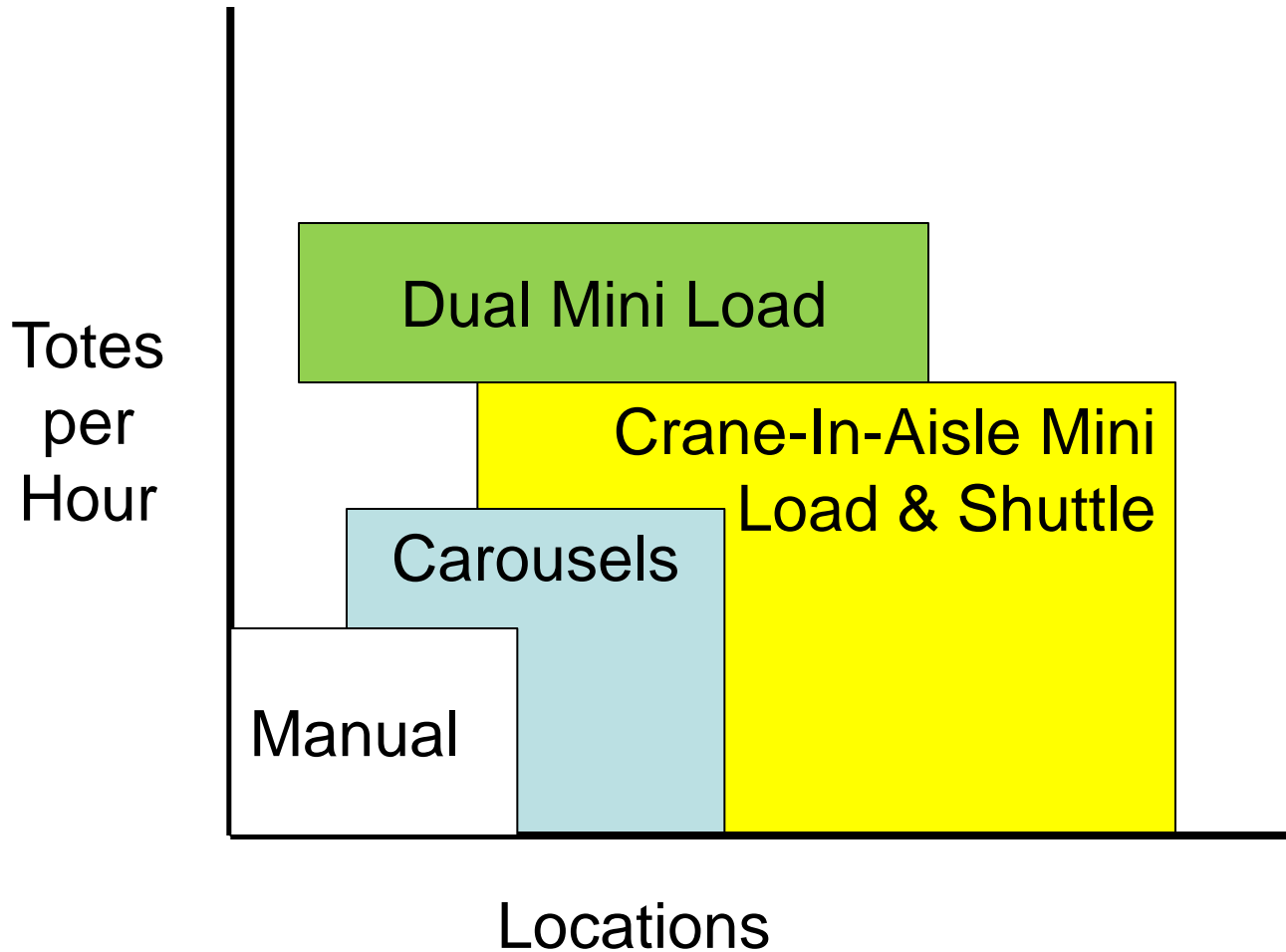
# Shuttle Type Mini Load



# Shuttle Type Mini Load



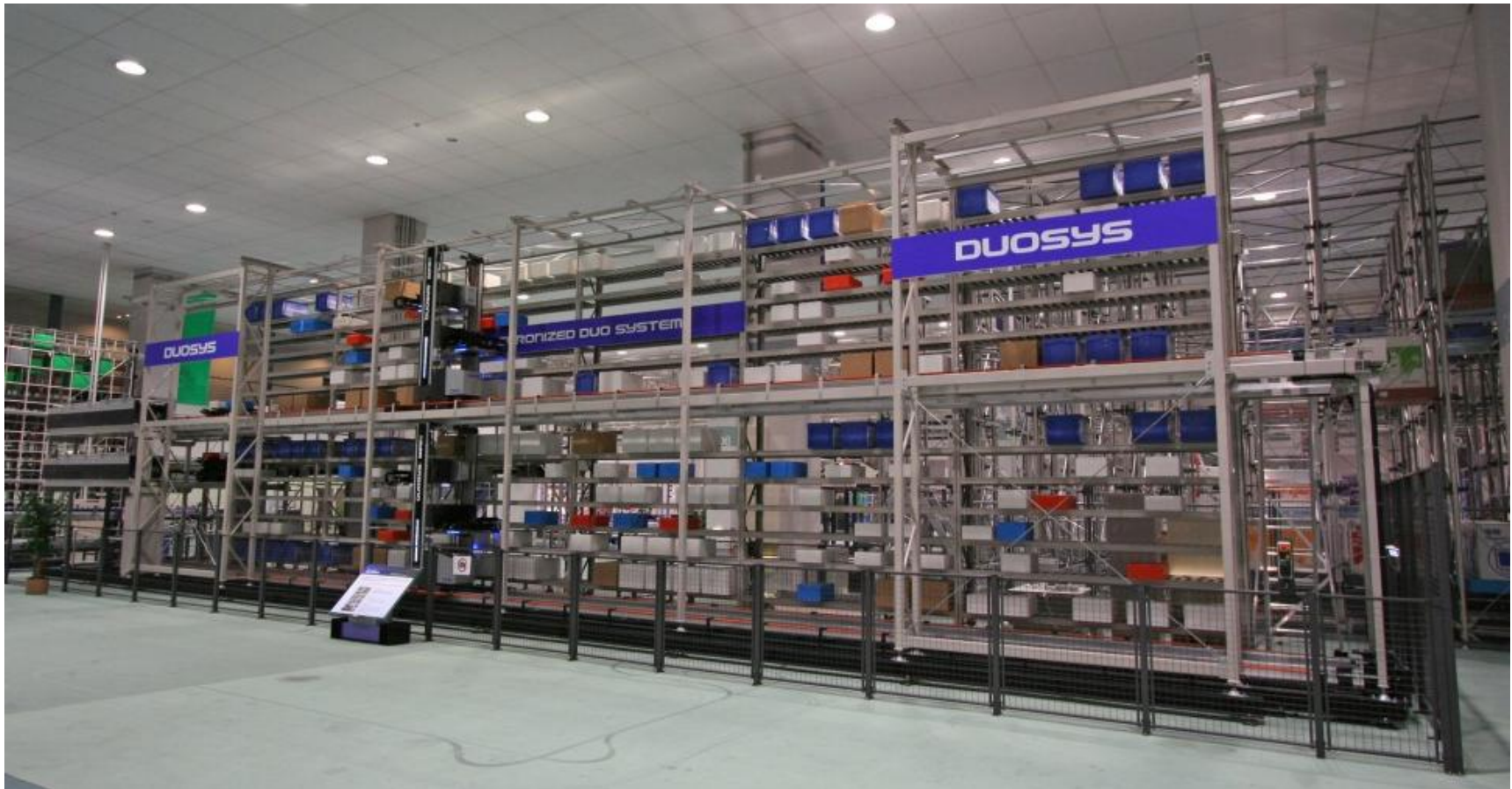
# Rate vs. Storage



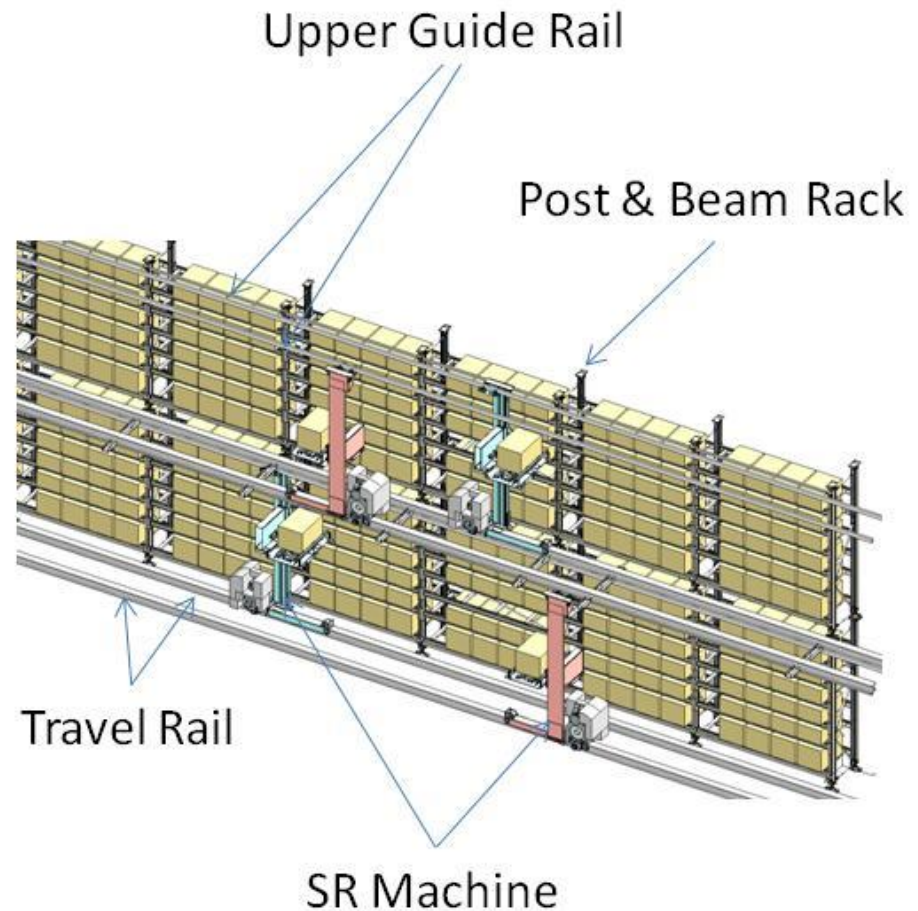
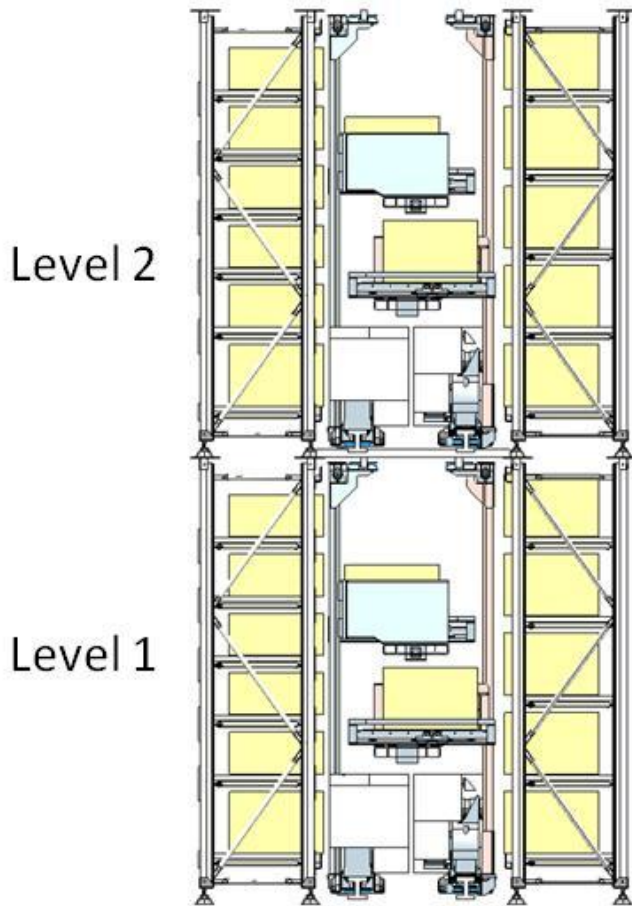
# Dual Mini Load



# What's different about Dual Mini Loads

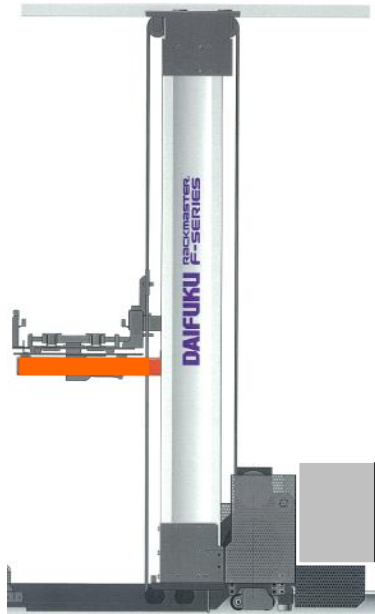


# Typical Dual Mini Load



# Dual Mini Load Video


# Specifications



- 300 m/min **Horizontal speed**
- 3.5 m/s<sup>2</sup> **Horizontal acceleration**
- 80 m/min **Vertical speed**
- 3.5 m/s<sup>2</sup> **Vertical acceleration**
- 2 s **Average transfer time**
- 30 kg 66 lbs **Maximum load weight**



# Heritage of High Speed Mini load



Year	2000	2002	2004	2006	2008
Concept	High Speed	High Acceleration	Fastest ML In the world	Responsive System	High System Throughput
Throughput	220C/H	x 1.5 → 330C/H	x 1.5 → 500C/H	x 1.6 → 800C/H	x 2.5 → 2200C/H
Acceleration	0.1G	0.3G	0.5G	0.6G	0.4G
Travel Speed	200m/min	200m/min	500m/min	400m/min	350m/min
Technology	Single Motor Drive	Twin Motor Drive	Synchronous Motor control 2 wheels & 4 motors High Traction Drive Anti Mast Sway	Lightweight (CFRP Mast) 2 SRM per Aisle Single CPU-Off-Board Ctrl	Multi Layer - Double Decker 2 SRM per Aisle & By-Pass Ctrl Offset Frame

Throughput above is based on best case scenario

Base Condition : Travel Stroke 20m, Clear Height 6m



# Features of Dual Mini Load

## High Throughput

- Two cranes work in the same aisle
- Cranes pass each other without interference

## Non-Stop System (Redundancy)

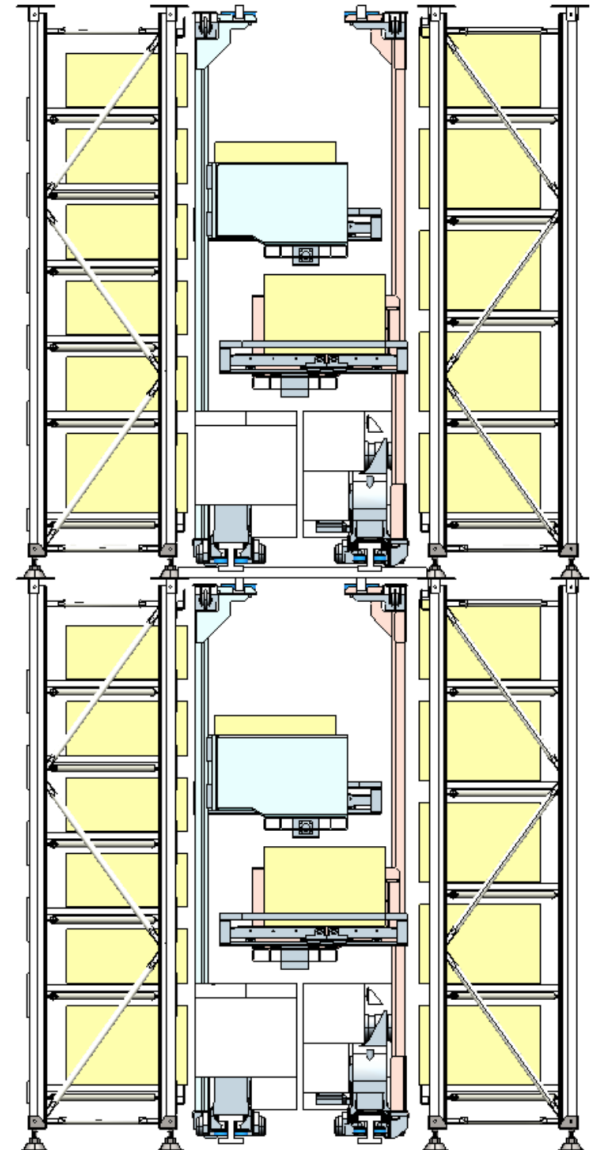
- When one crane stops
- Second crane continues working
- Accessing all locations

## Ecology System

- Lightweight design saves electricity
- Regenerative braking creates electrical power that is sent to the other crane through a regenerative converter
- One SRMs is inactive during low utilization

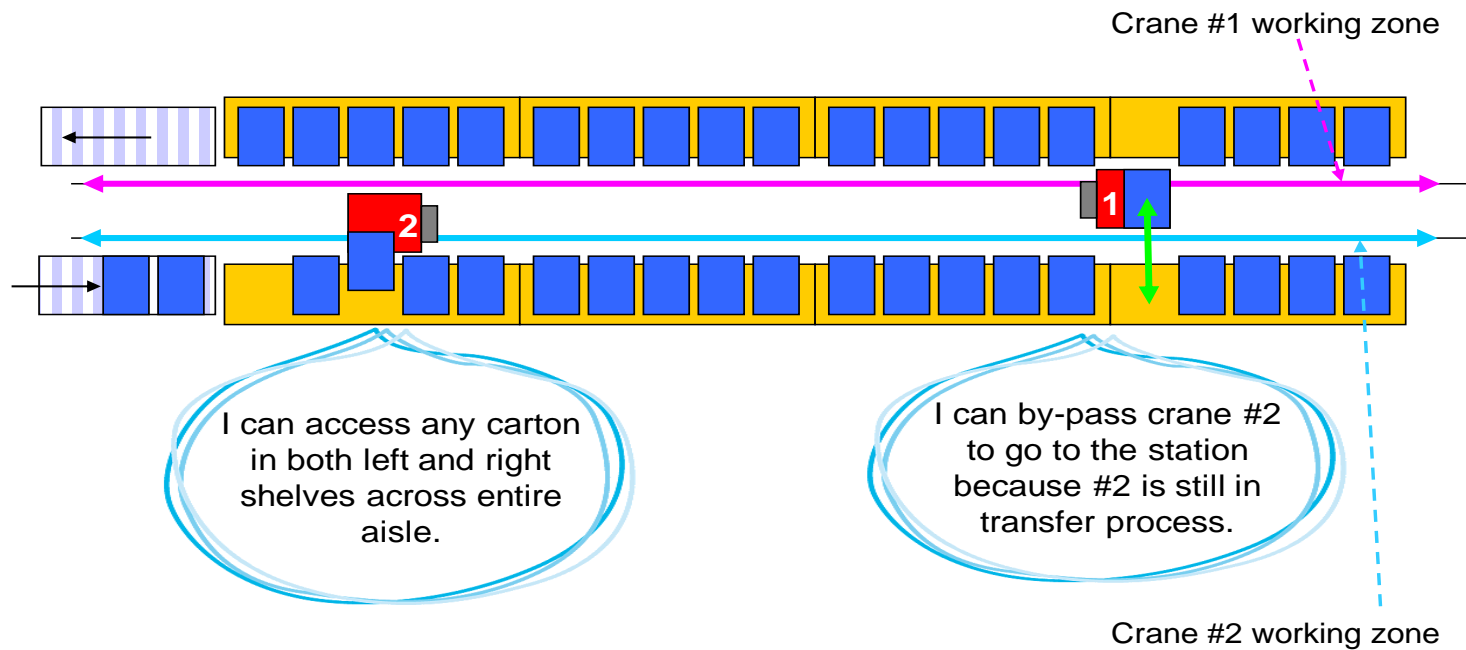
## High Maintainability

- One crane can be maintained while the other is working
- Maintenance can be systematically implemented by controlling the numbers of active SRMs.



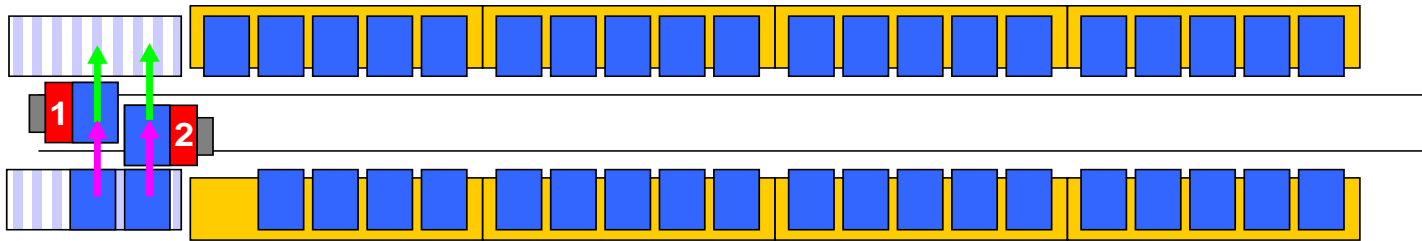
# Synchronous Control

2 cranes works in one aisle moving past each other without interference



# Simultaneous Transfer

Unloading and loading transfer at the conveyor



Non-stop Transfer  
No idle time  
 2 SRM do unloading  
 and loading at the  
 same time!

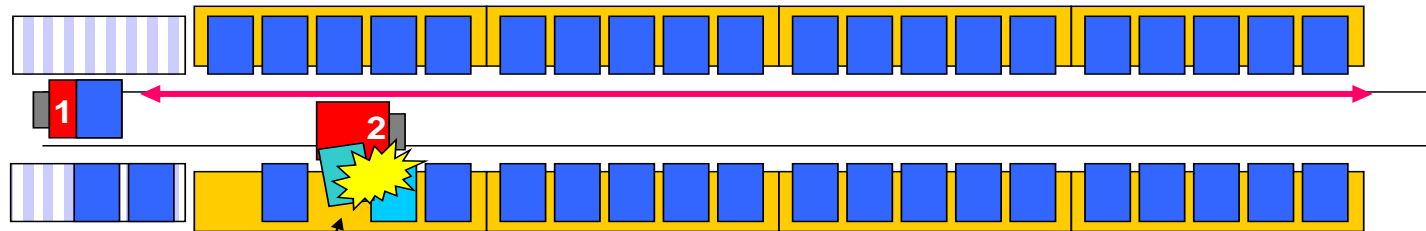
\*1 : Not applicable to fork extractor alone.

Patent pending


# Non-Stop System


## High Availability

Crane 1 works, with load error on crane 2



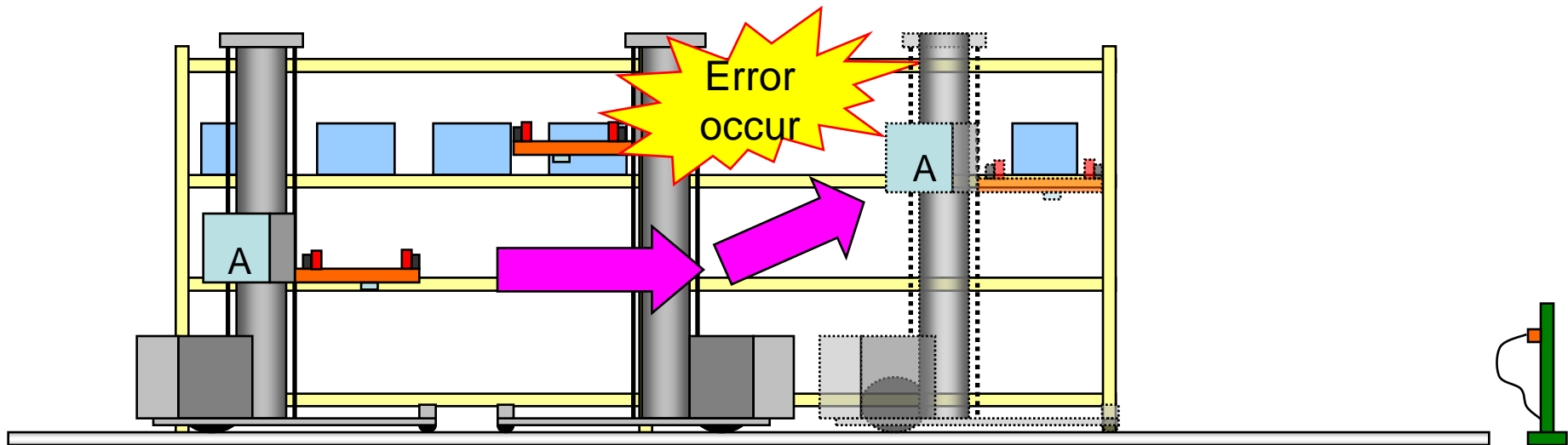
e.g. load size error

 Carton accessible by crane #1

 Carton not accessible by crane #1

# Non-Stop System

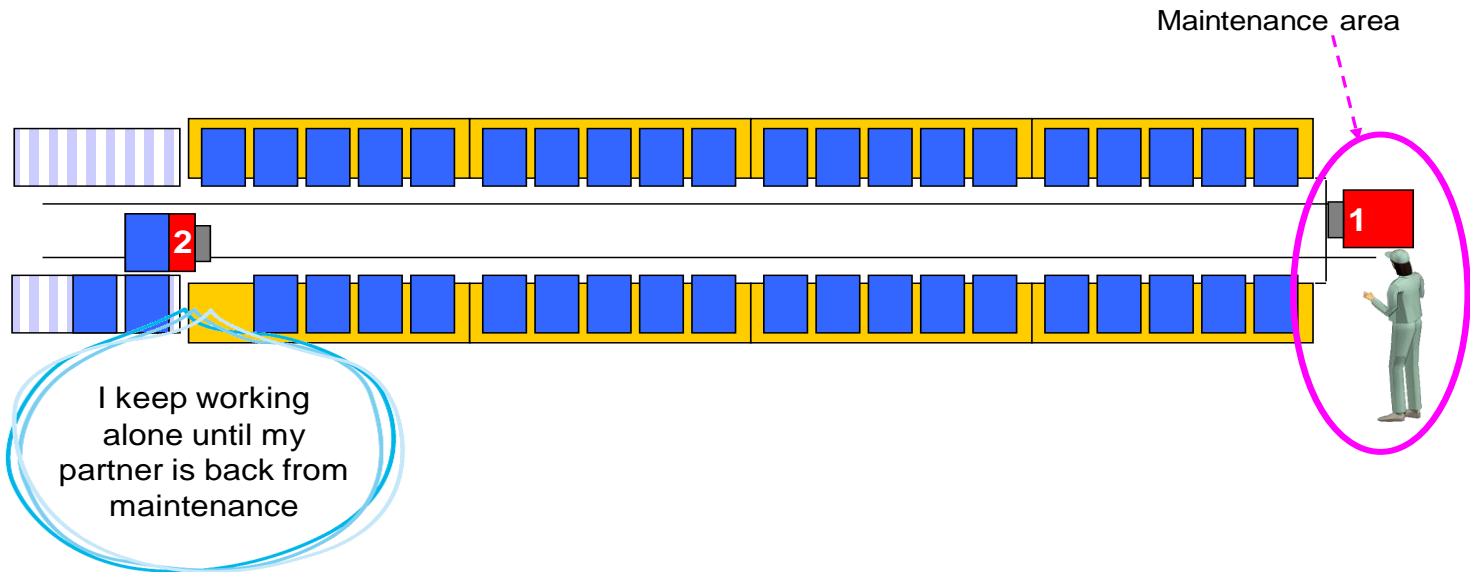
- One crane encounters a bad case
- Other crane can by-pass and continues to operate



# Non-Stop System

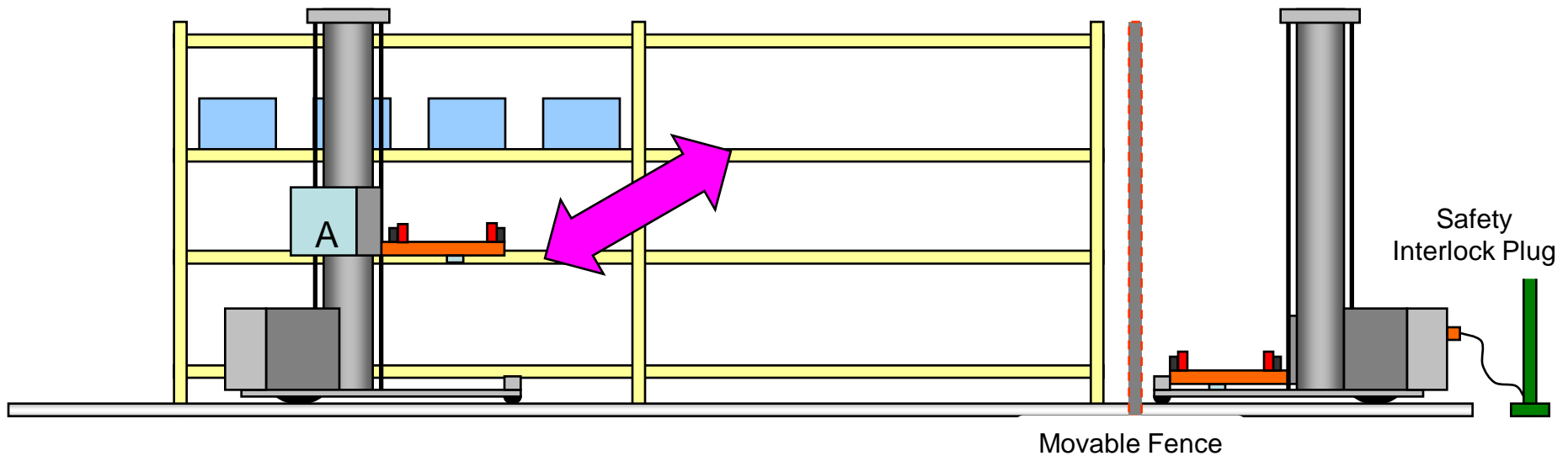
## High Maintainability

System remains in operation while maintenance is performed on one SRM. Maintenance can be systematically implemented by controlling the numbers of operations of individual SRM.



# Non-Stop System

- One crane can be maintained
- While other crane continues to operate





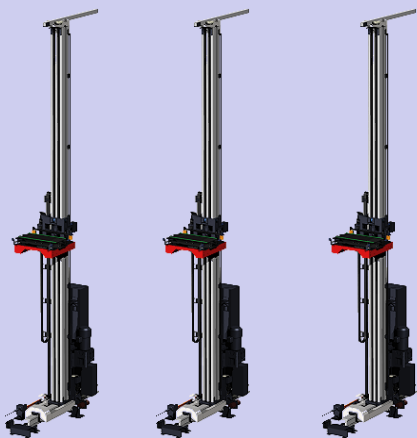
# Ecology System

Example 600 cases/hr

## Conventional Miniload

- Model R-P1
- x 3 aisle 3SRM
- Without regenerative converter

15.4 [kWh]



Weight Savings 30%

Regen Savings 38%

Accel adder 20%

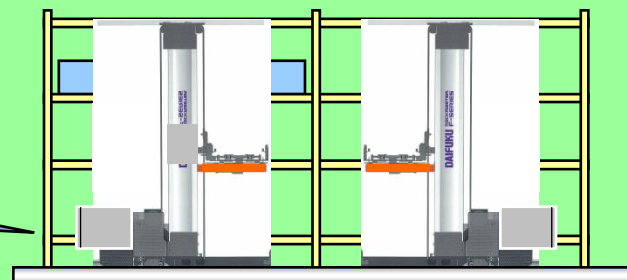
Horizontal: 350m/min 0.4G  
 Vertical: 40m/min 0.3G

Horizontal: 200m/min 0.1G  
 Vertical: 40m/min 0.15G

## Model Dual Mini Load

- x 1 aisle 2SRM
- With regenerative converter

8.1 [kWh]



Energy Saving 48%

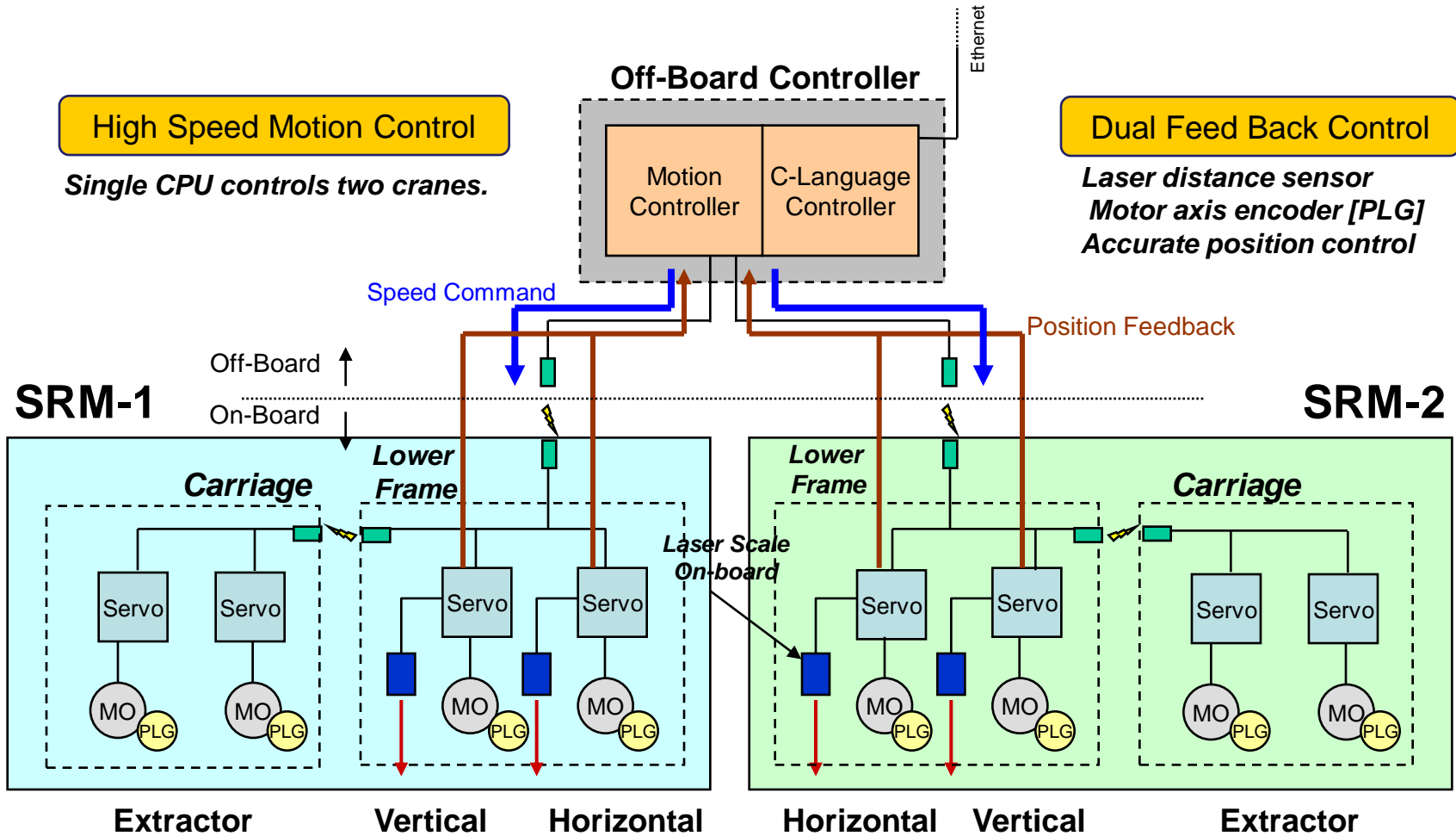
# Collision Proof Technology

**High Speed Motion Control**

*Single CPU controls two cranes.*

**Dual Feed Back Control**

*Laser distance sensor  
 Motor axis encoder [PLG]  
 Accurate position control*



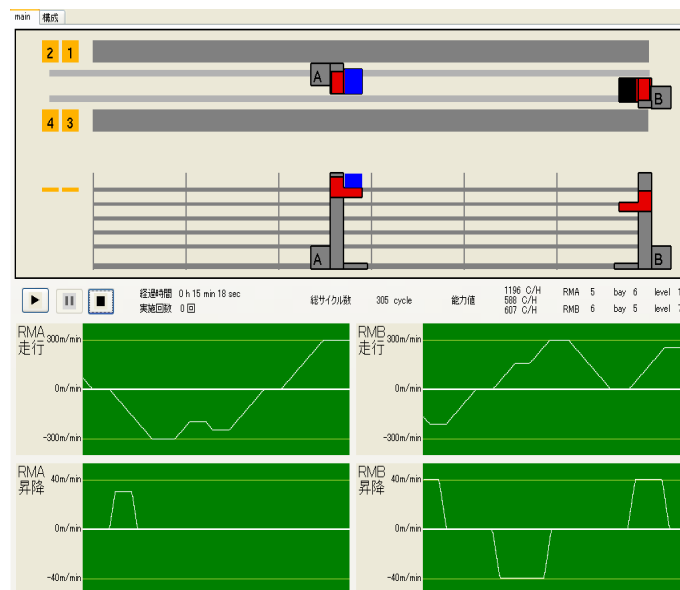
# Verification of Collision Proof

## Simulation Test

- 10 years of duty cycles on software.
- Simulation software incorporating all logic proved no collision or deadlock.

## Real Machine Test

- 700,000 cycles tested by prototype
- Installed 3 test sites
- Many cranes installed
- Over 100,000,000 cycles, no collisions



Screen Shot of Simulator

# Benefits

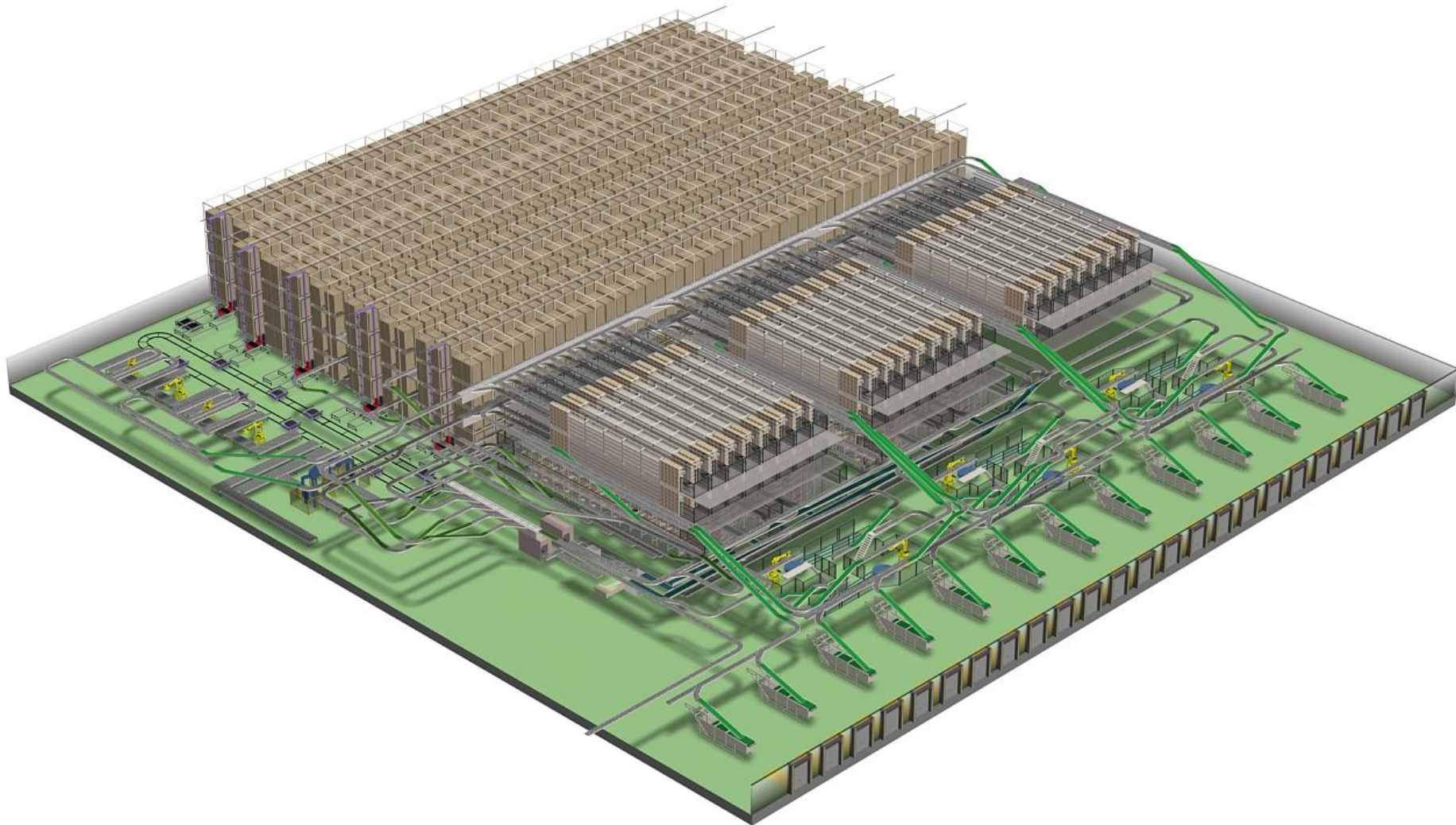
- Speed
- Rack Side Delivery
- Multiple Level Output for Sorting
- Flexibility in Load Size
- Simultaneous Transfer
- Reliable
- Save
- Proven Technology



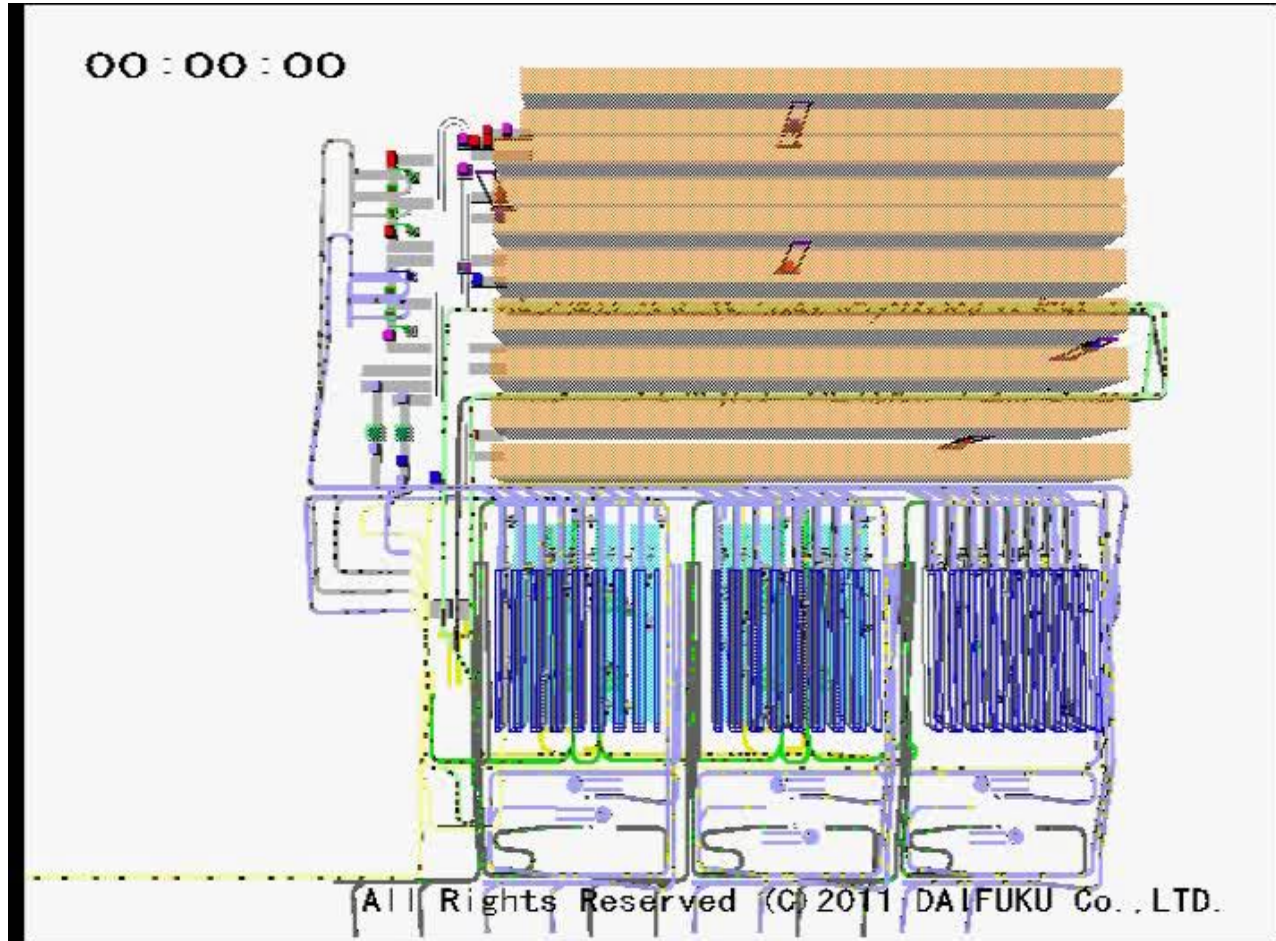
# Case Study

## Order Sequencing

# Order Sequencing System

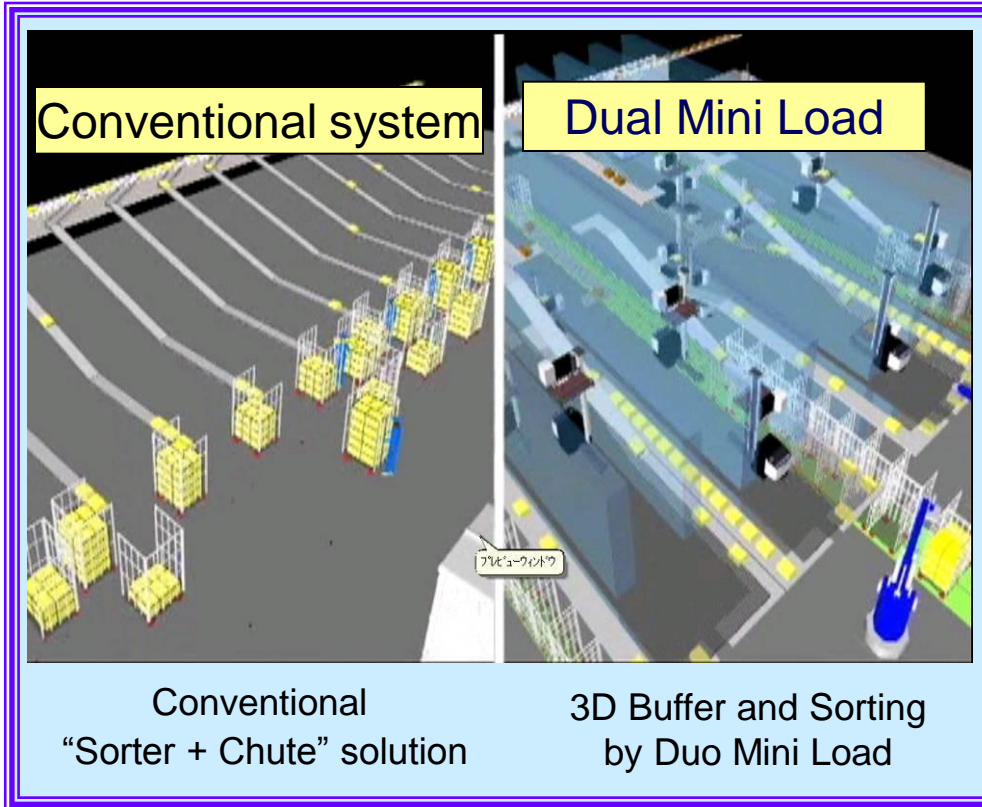


# Sequencing Simulation Video



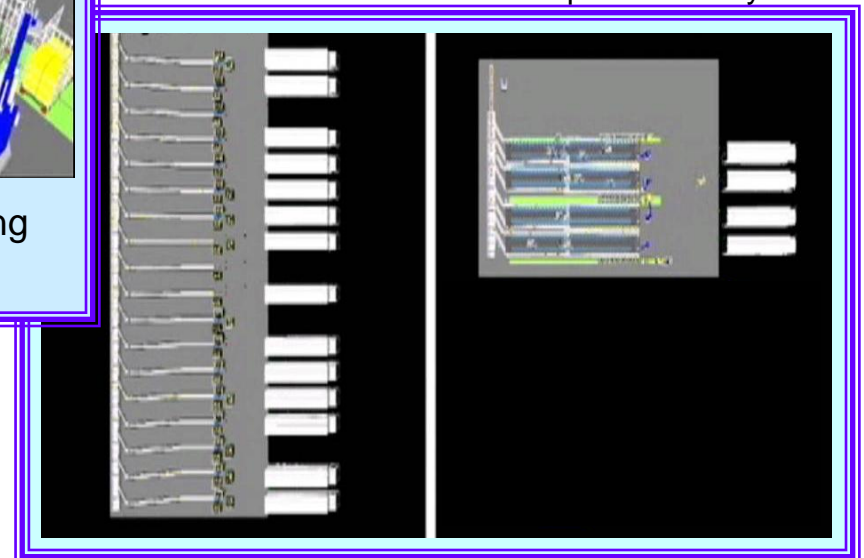


# 3D Sorter for Shipping



Dual Mini Load changes the conventional "Sorter + Chute buffering" solution to new "3D Buffering & Sorting" solution, allowing your shipment to be prepared in exact sequence in a shorter period in less space.

horizontal space is cut by 50%





# Distributed Sequencing

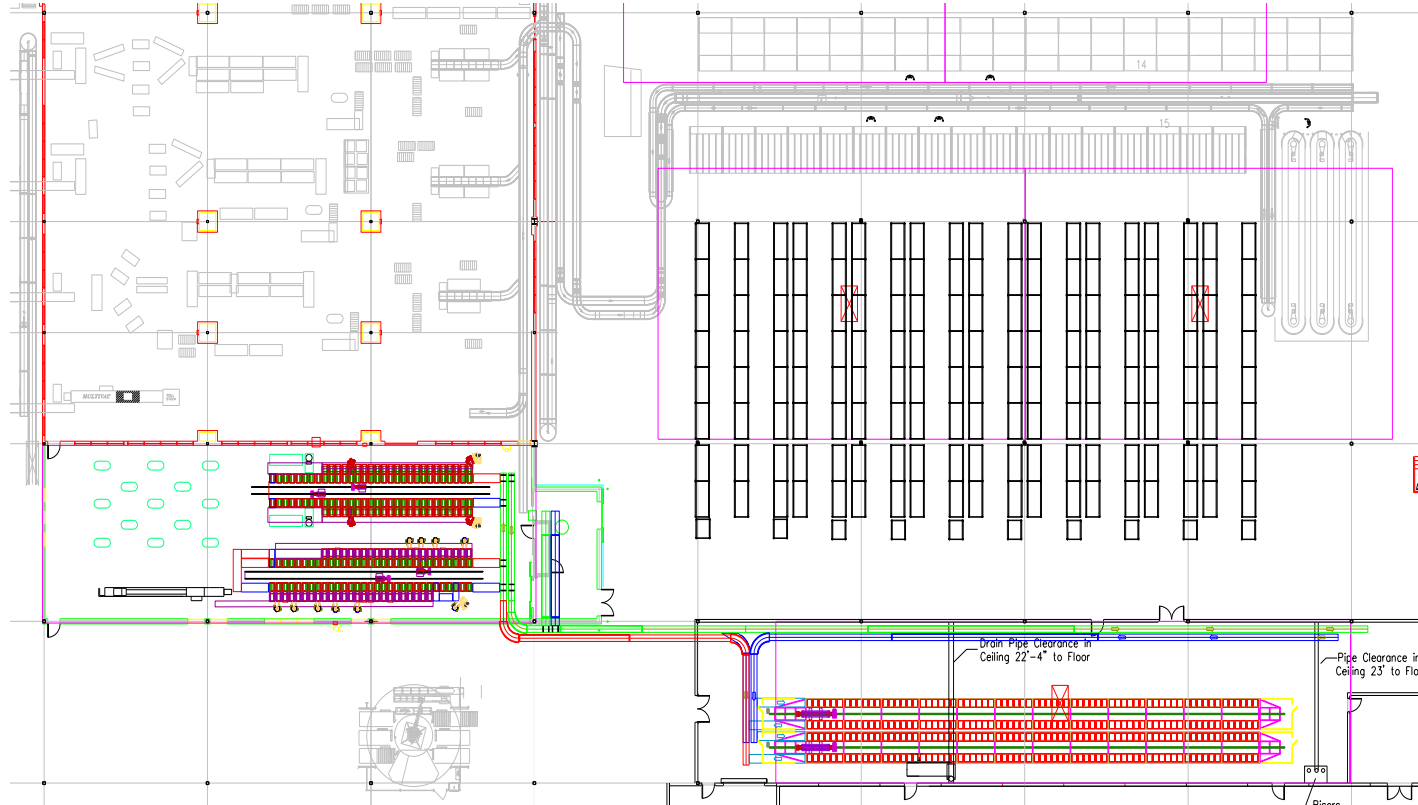


# Case Study

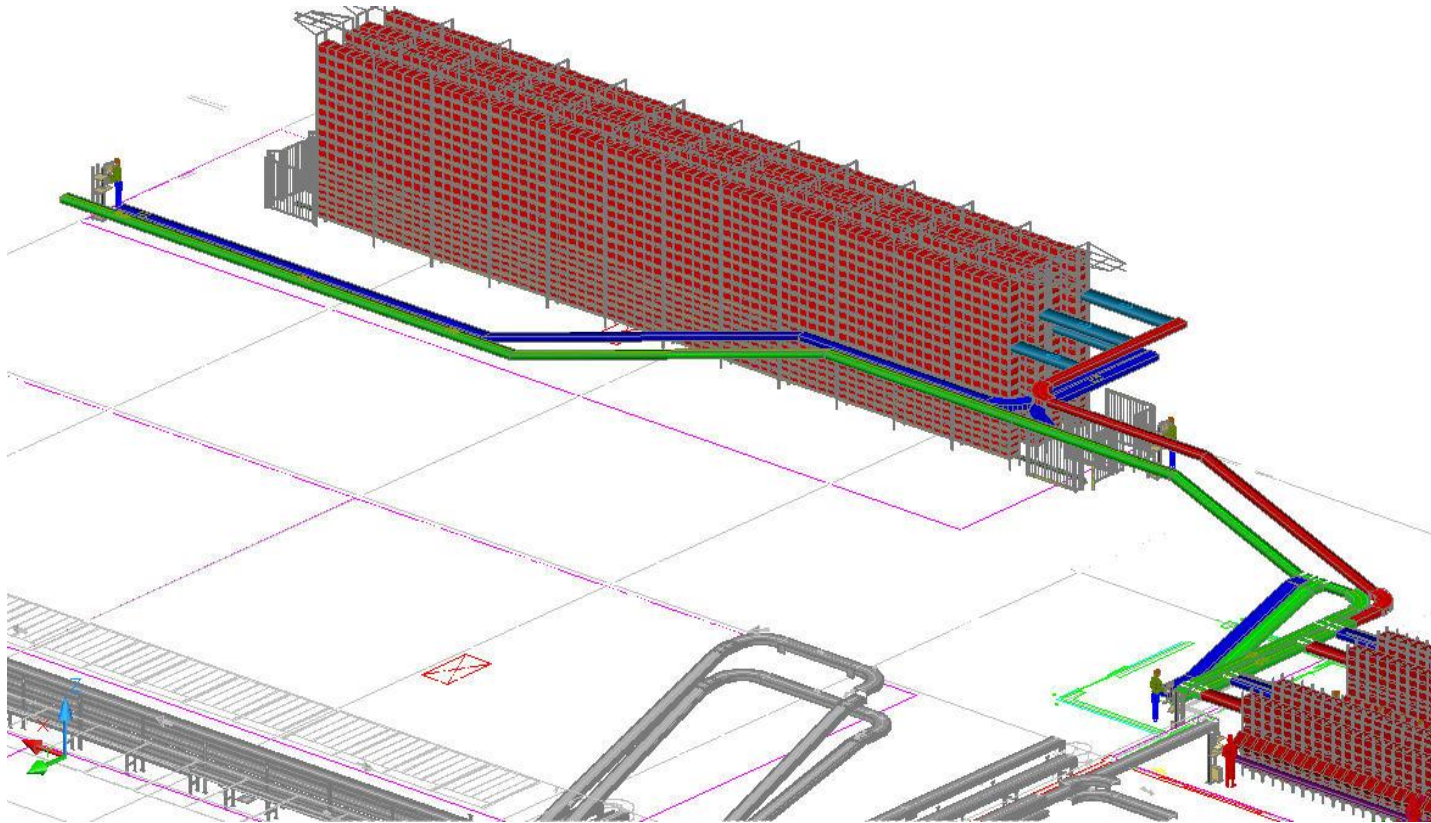
## Rack Side Picking



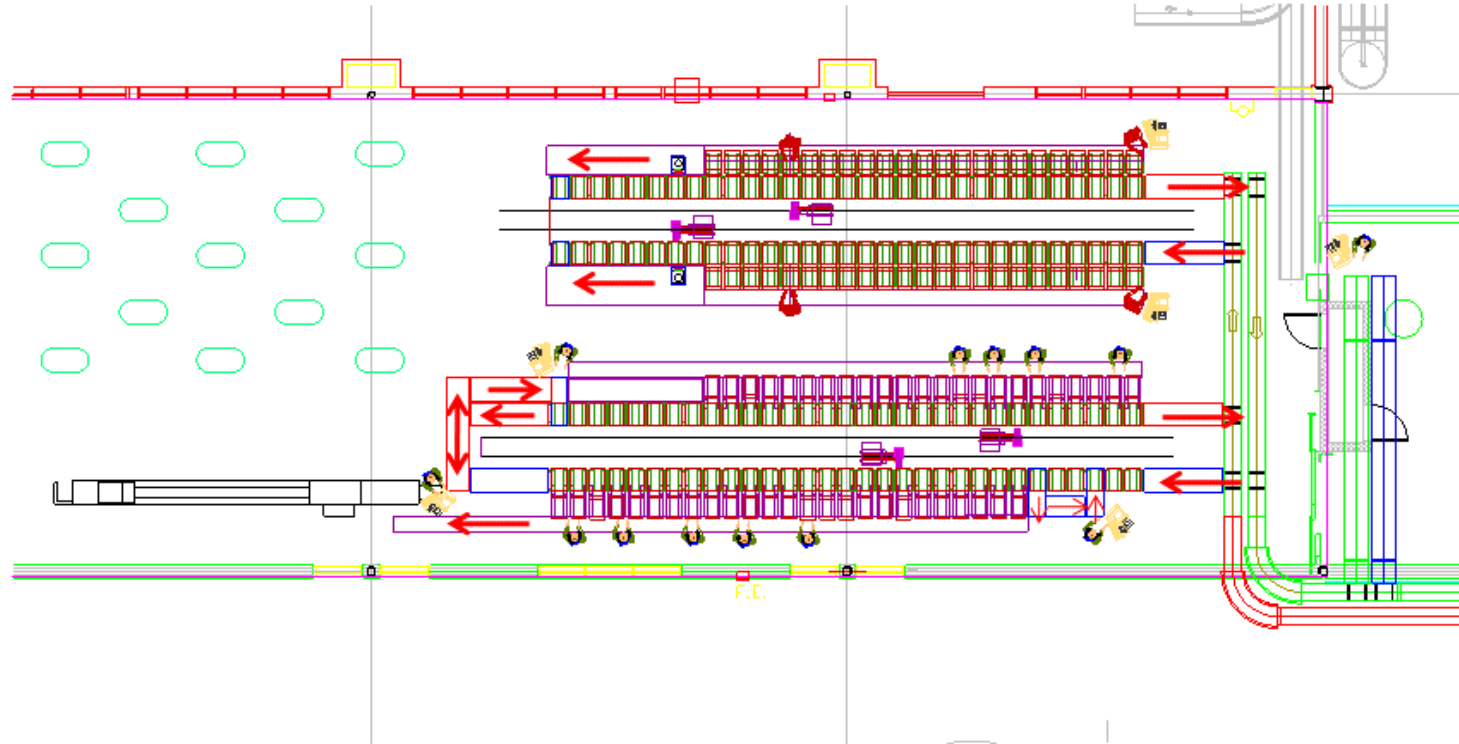
# Overall System



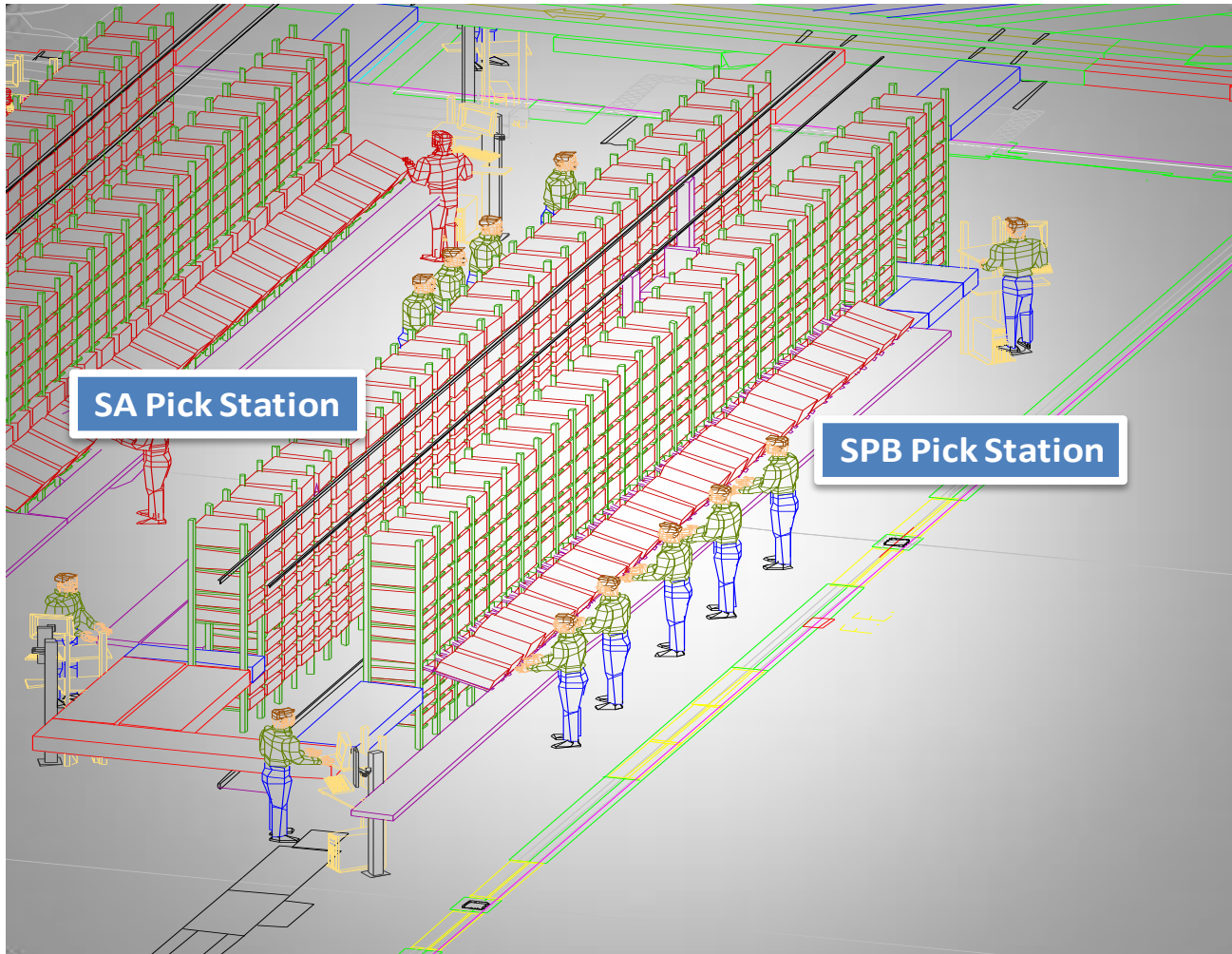
# ML feeds Dual Mini Load



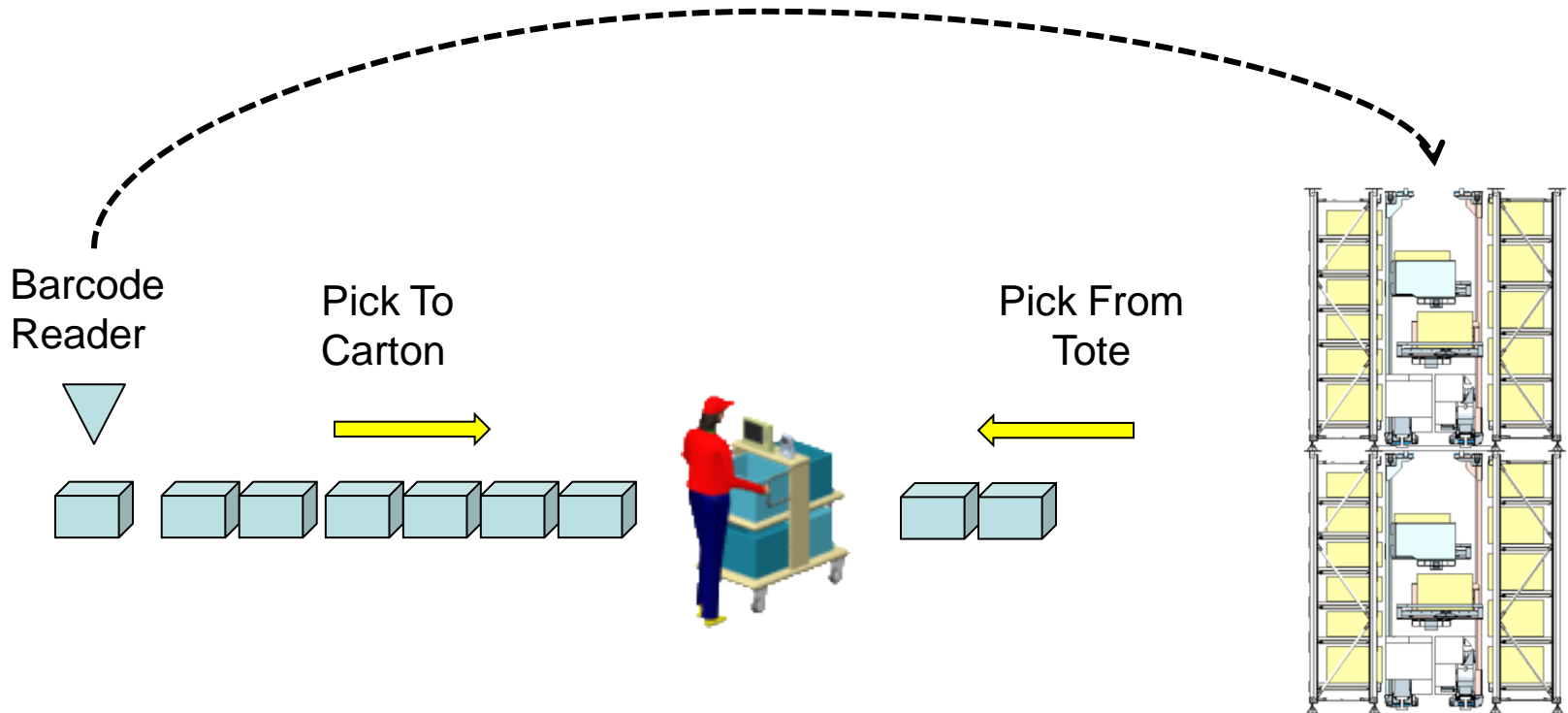
# Plan of Dual Mini Load



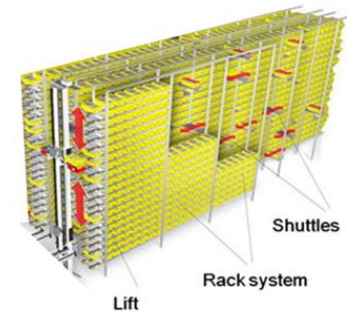
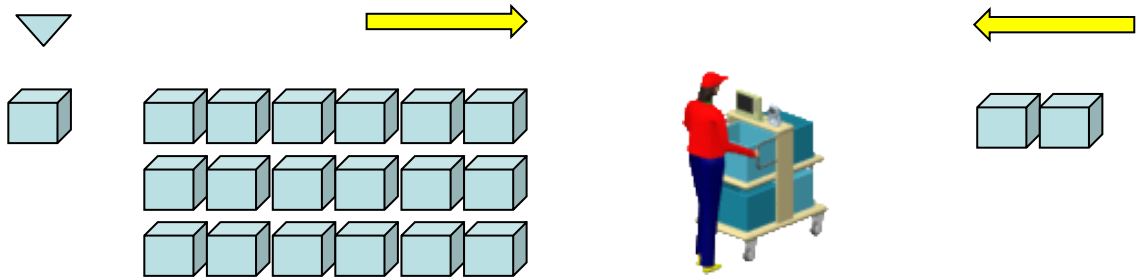
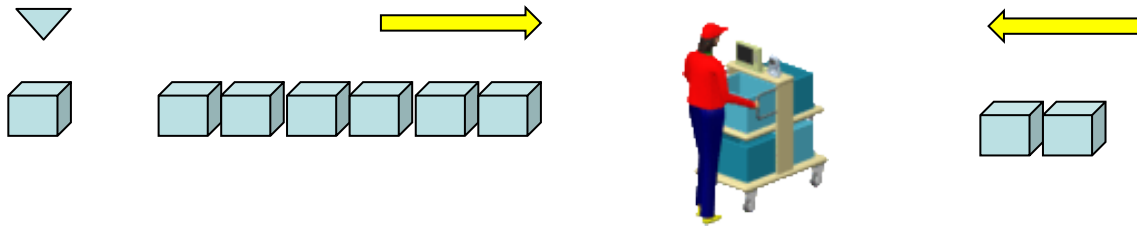
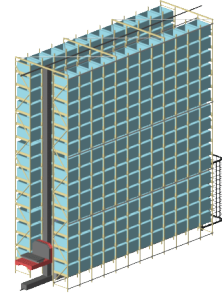
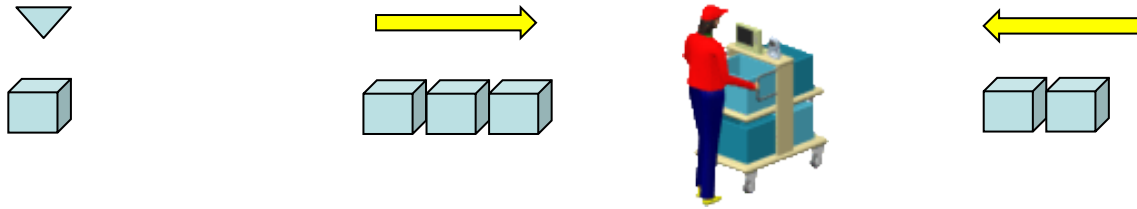
# Rack Side Picking



# Work Flow



# Work Flow





# Dual Mini Load Summary

- Dual Mini Load is a NEW Application
- AS/RS as “Vertical Sorter”
- Not a New Technology
- Dual Mini Load was developed based on Field Proven AS/RS Components
- High Speed Evolution
  - Intensively pursuing High Speed, High Throughput SR Machines since 2000
  - Dual Mini Load Speed Evolution is Field Proven
- Added features
  - Ecology, Redundancy, and Maintainability
- Dual Mini Load is one part of Automated Storage
  - Can be combined in system depending on application
- Collision Proof Software is proven with over 100,000,000 cycles
- Dual Mini Load was developed aiming at high speed sequencing and picking systems



***For More Information:***

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