BOSCH CHINA IoT HACKATHON
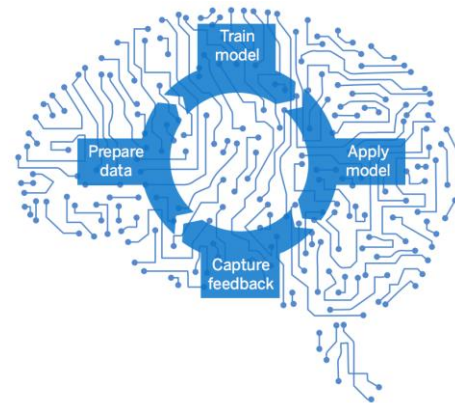# Connected Industry
Connecting
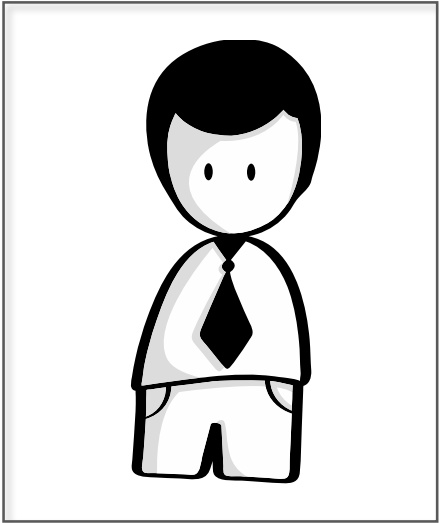
CLOUD COMPUTING   BIG DATA   MACHINE LEARNING   IoT

Frank

Turnover box Manager in BOSCH

"I want to reuse and recycle the parcels in Bosch supply chain. Low cost, high efficiency"

- **BOSCH takes lead and combine all the partners in BOSCH supply chain to share and recycle the turnover boxes and pallets.**

Scenario
- B2B: Bosch, its suppliers and OEMs
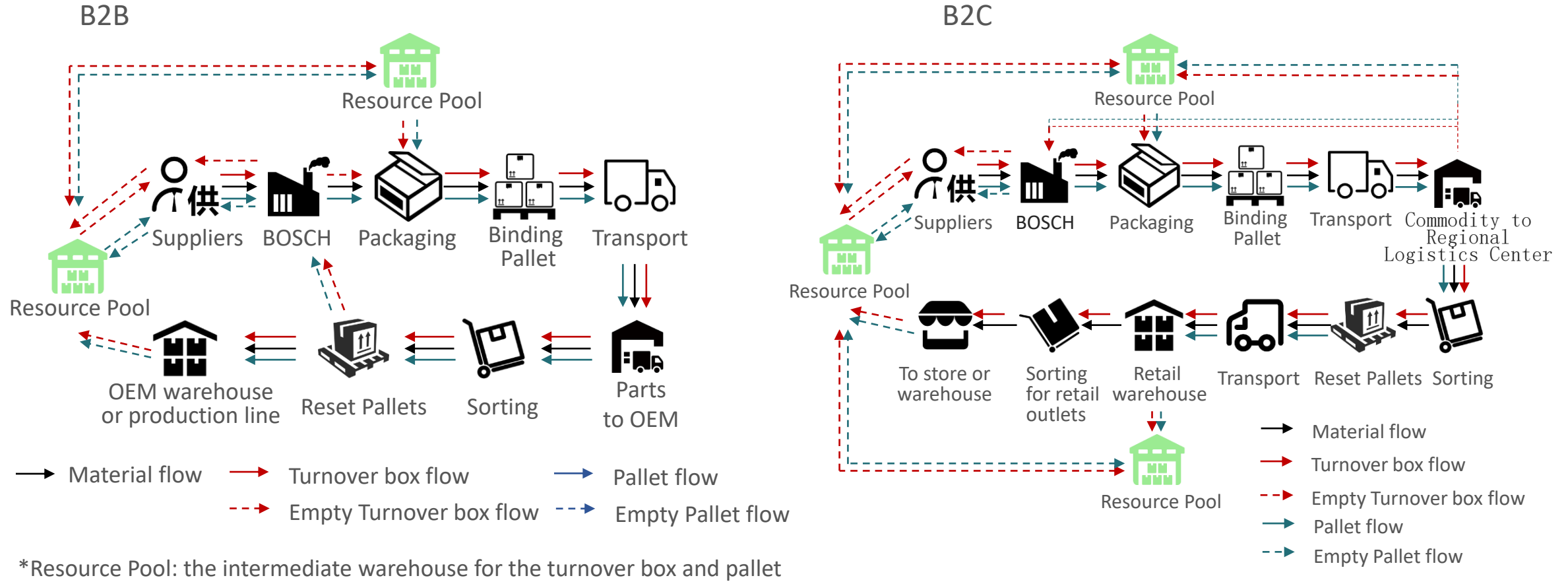- B2C: Bosch, its suppliers and retailers

Pain Points
- Huge labor costs in packaging process
- The hardware cost is huge
- Unable to manage millions of turnover boxes
- Bullwhip effect
- Poor user experience
- Low circulate turnover rate
- ......

Target
- Reusable, expandable turnover box.
- Reasonable and feasible, turnover and recycling management plan
- Business model for circulation and management of large number of turnover boxes.
- ....

B2B

Resource Pool

Suppliers — BOSCH — Packaging — Binding Pallet — Transport

Resource Pool

OEM warehouse or production line — Reset Pallets — Sorting — Parts to OEM

→ Material flow → Turnover box flow → Pallet flow
⇢ Empty Turnover box flow ⇢ Empty Pallet flow

*Resource Pool: the intermediate warehouse for the turnover box and pallet

B2C

Resource Pool

Suppliers — BOSCH — Packaging — Binding Pallet — Transport — Commodity to Regional Logistics Center

Resource Pool

To store or warehouse — Sorting for retail outlets — Retail warehouse — Transport — Reset Pallets — Sorting

Resource Pool

→ Material flow
→ Turnover box flow
⇢ Empty Turnover box flow
→ Pallet flow
⇢ Empty Pallet flow

Circulation & Control

Pain Point 1

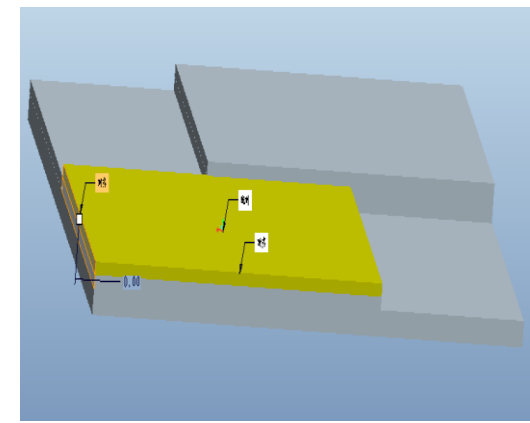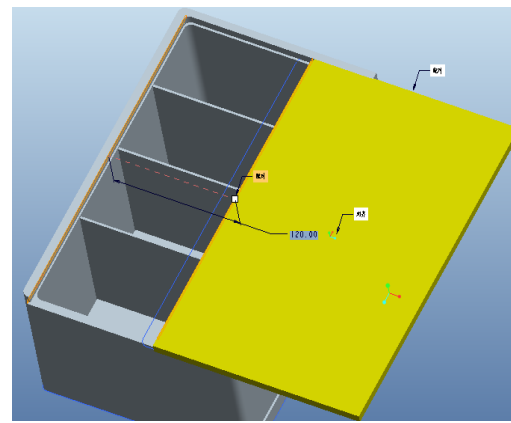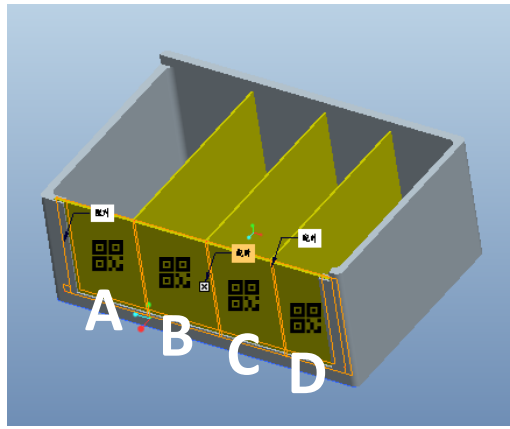- Huge labor costs in packaging process
- Packaging costs of disposable materials
- Low internal space utilization

Solution

Recyclable modular turnoverbox

Demo

3D model of turnoverbox
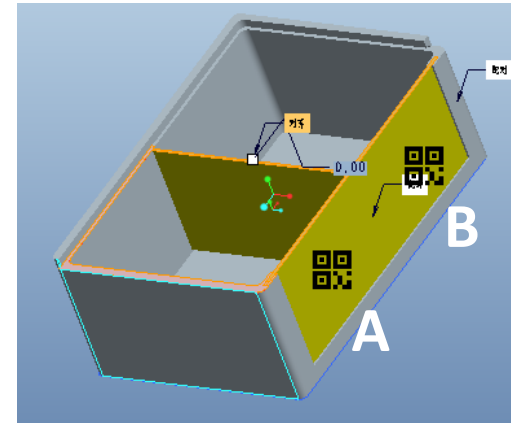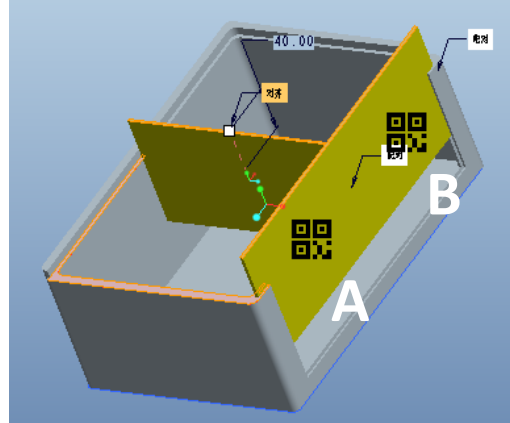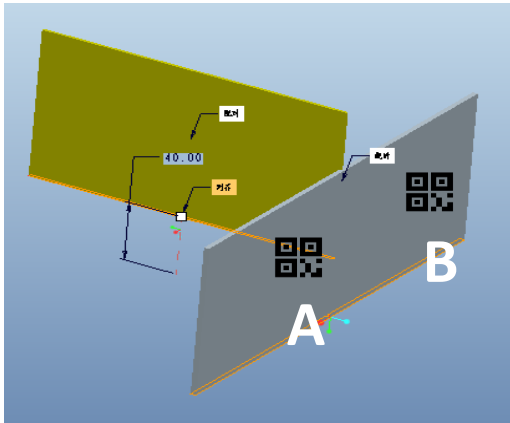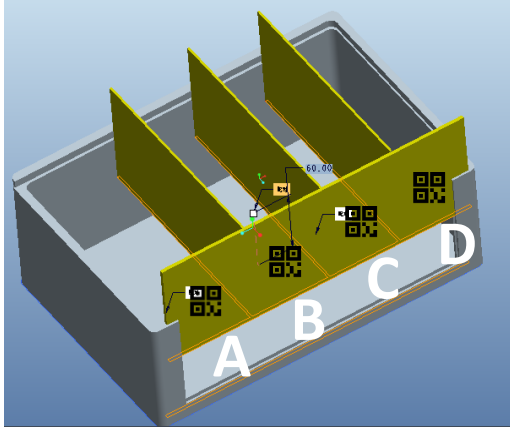
- Modular turnover box, quick assembly like building blocks
- The number of partitions can be adjusted flexibly (One Qrcode, one type of part)
- Collapsible, saving space during dispatching.

Pain Point 2

- Hardware unit in each turnover box, the hardware cost is huge
- Unable to manage millions of turnover boxes

Solution

Cascade mode, unitized logistics for turnover box, pallet and truck

System Structure

Device Connectivity
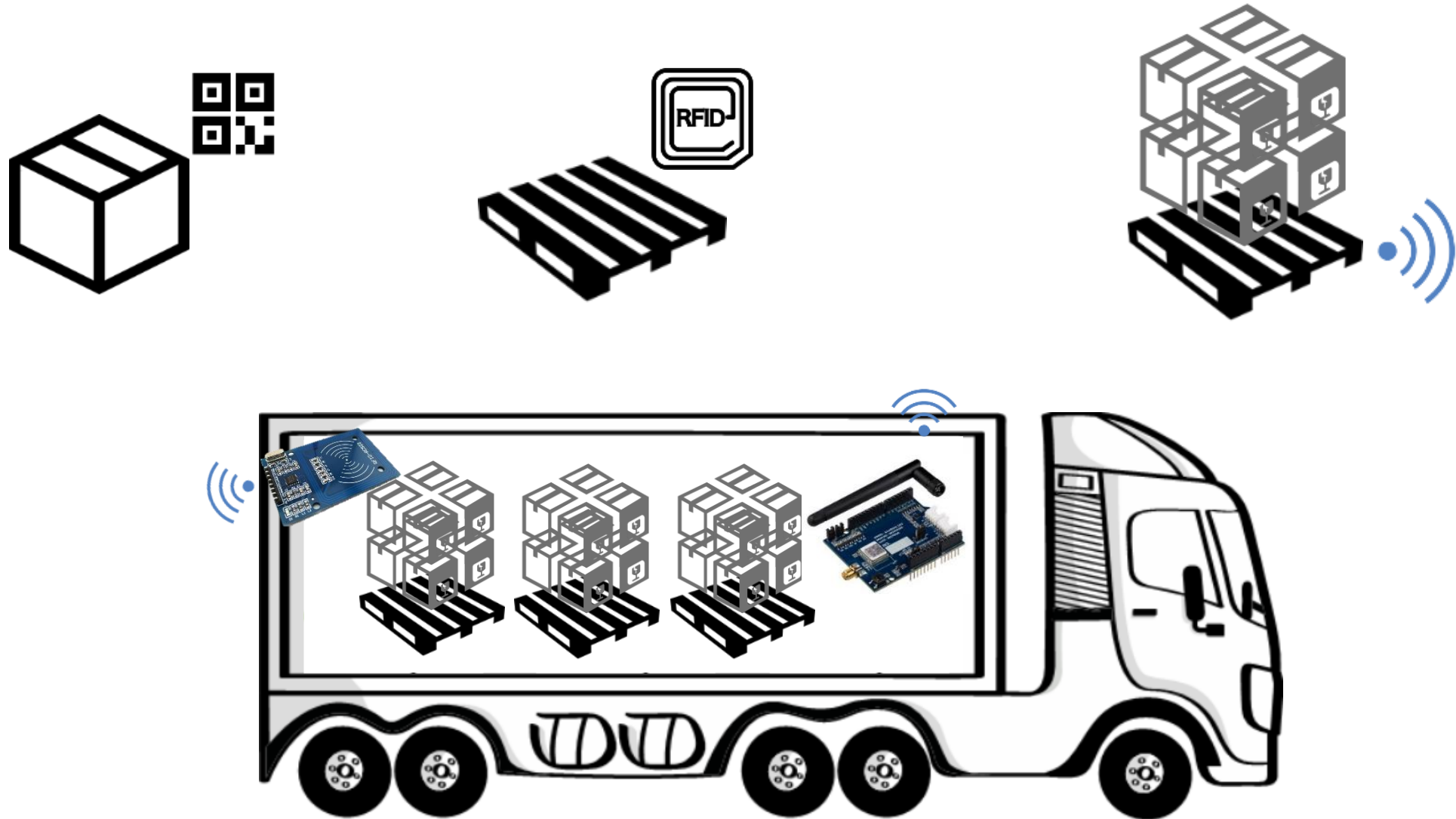
Turnover box

Pallet

Truck

Arduino

Data Processing, Analytics and Management

Gateway

Provisioning API

Identity and Registry Stores

Device State Store

App Backend

Stream Processors

Storage

Analytics & Machine Learning

Presentation & Business Connectivity

Business Integration Connector and Gateway

Mobile devices

Turnover management cloud

Bosch sensors

NODEMCU

MQTT / HTTP

Arduino

RFID reader

AZURE IoThub

Stream Processors

AZURE SQL

Turnover management cloud

Technical realization


```
COM3                                    —  □  ×
                                                发送
@71BBCB2E#C001$In use%
Sending value Car_id = C001
, Pallet_id = 71BBCB2E
, Status = In use

IoTHubClient accepted the message for delivery

@EE716073#C001$In use%
Sending value Car_id = C001
, Pallet_id = EE716073
, Status = In use

IoTHubClient accepted the message for delivery

自动滚屏      换行符 ▾  115200 波特率 ▾   Clear output
```

Device to cloud messages (IOTHUB79)

```
10
9
8
7
6
5
4
3
2
1
0
   上午4时  上午5时  上午6时  上午7时  上午8时  上午9时
```

TELEMETRY MESSAGES SENT (计数)
IOTHUB79

9

```
1  SELECT
2      Pallet_id,Car_id,Status,EventProcessedUtcTime as Time
3  INTO
4      output
5  FROM
6      input
7  WHERE
8      Car_id LIKE 'C%%%'
```

Arduino + RFID-Reader read RFID tag information

IoT Hub receives information from Tag

Appropriate stream processing, filter invalid information

正在监视

```
9
8
7
6
5
4
3
2
1
0
   上午8:30   上午8:45   上午9时   上午9:15
INPUT EVENTS ⓘ    OUTPUT EVENTS ⓘ
      9                  7
```

Stream processing

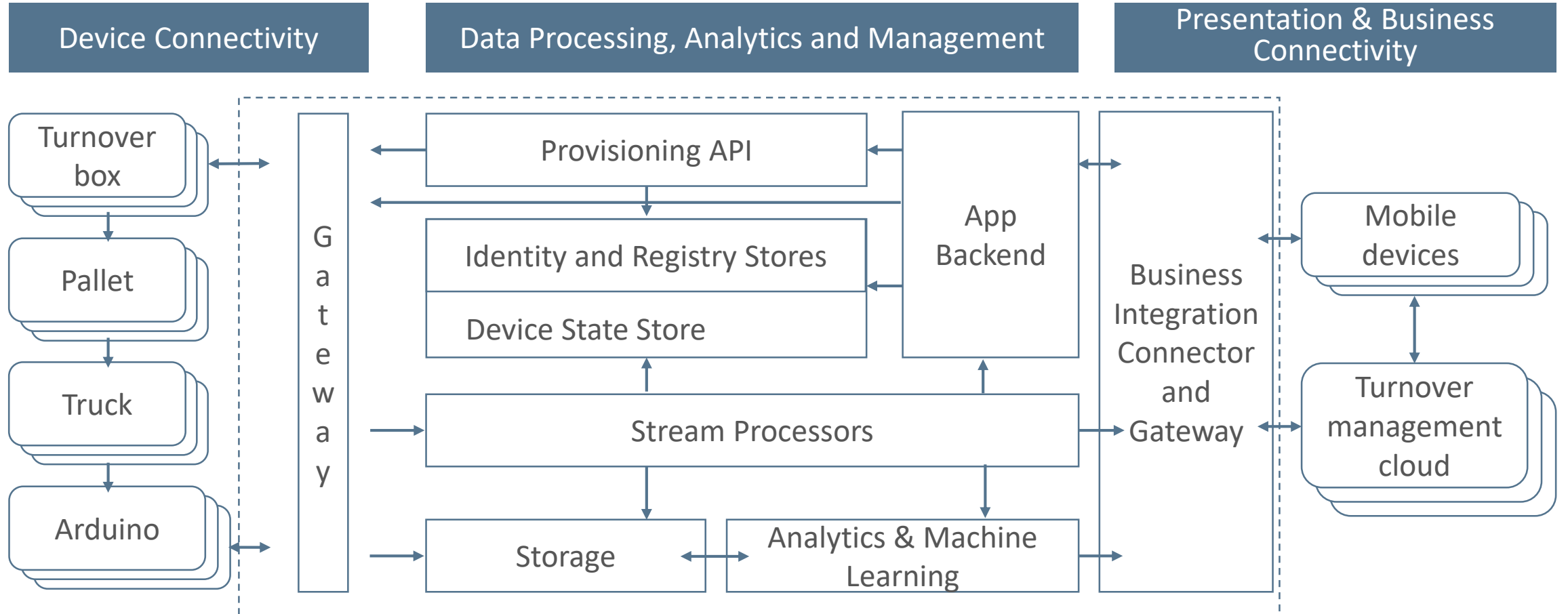| 55	00FE5AD3	In use	C001	2018-07-20T01:25:25.85...
56	6717630C	In use	C001	2018-07-20T01:25:25.85...
57	C7BE52D3	In use	C001	2018-07-20T01:25:25.85...
58	EAB33D2E	In use	C001	2018-07-20T01:25:25.96...
59	C0D38925	In use	C001	2018-07-20T01:25:25.96...
60	71BBCB2E	In use	C001	2018-07-20T01:25:25.96...
61	EE716073	In use	C001	2018-07-20T01:25:33.54...

Database update

Pain Point 2

- hardware unit in each Turnover box, the Hardware cost is huge
- Unable to manage millions of Turnover boxes

Solution
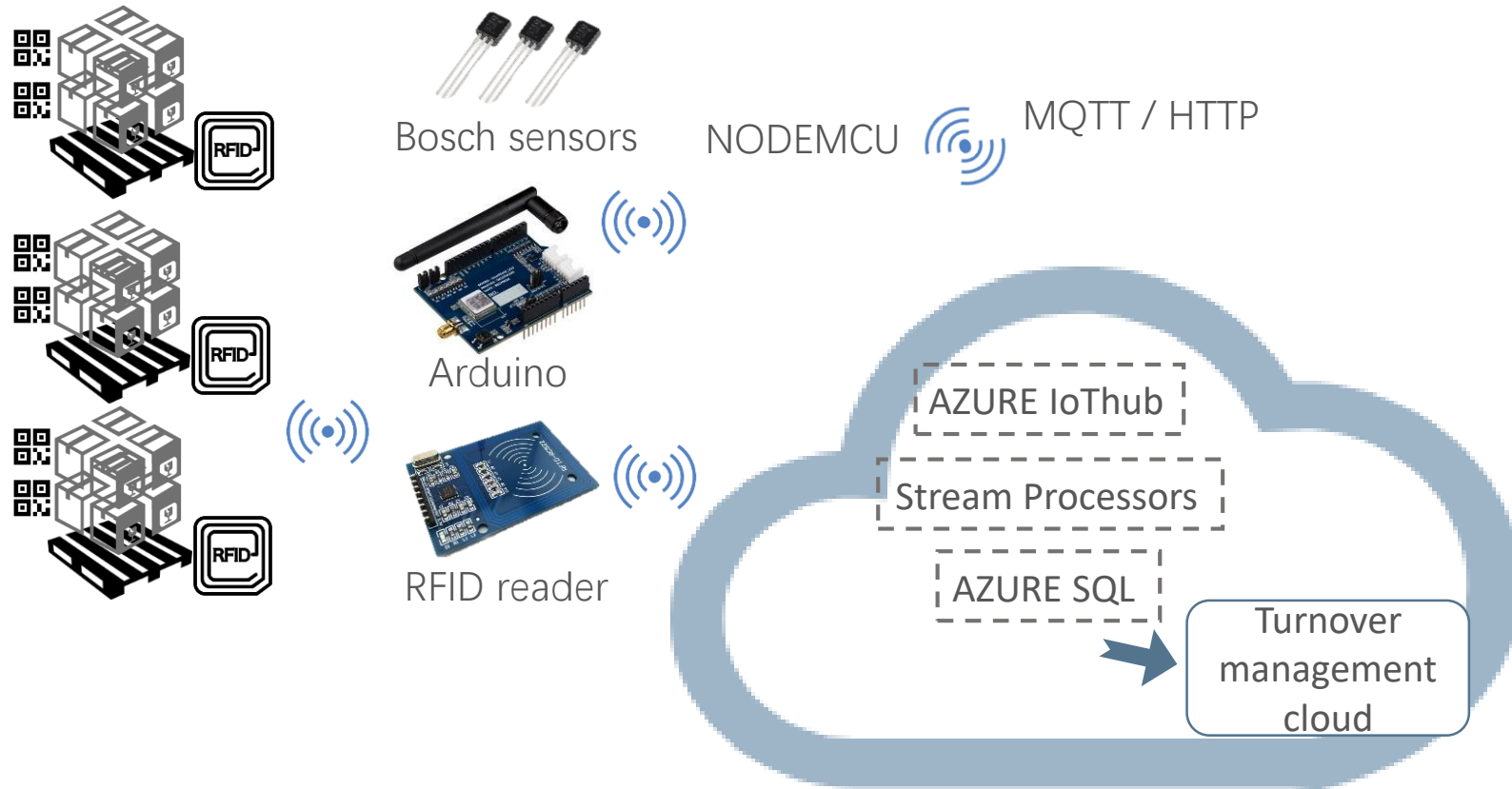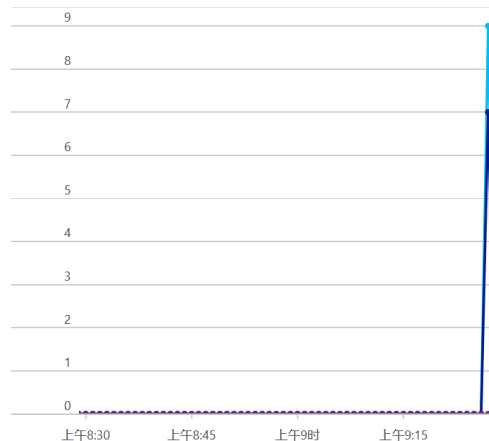
Cascade mode, unitized logistics for Turnover box, Pallet and truck

Benefits

- 16 turnover boxes in 1 pallet
- 30 pallets in 1 truck
- Reduce hardware modules to 1/480
- Optimize the logistics quality of supply chain through cascade mode & unitized logistics

Pain Point 3

- # Bullwhip effect

-Demand information in the supply chain fluctuating

-End users can't get enough turnover boxes in time

Solution

Forecast future demands of the User

Demo

- Peak hours analysis
- Least squares polynomial regression

Pain Point 4

• Poor user experience

-Not enough turnover boxes near the user

-Long dispatching distance cause high charge

Solution

Reasonable resource pools selection

Improve service level

Demo

• Machine learning K-MEANS location selection optimization

Pain Point 5

- The transport truck is fully loaded when leave, but empty when return
- Low circulate turnover rate

Solution

Turnover box resource dispatching

Credit Rating

Active: pricing rule

Passive: timeout management

Demo

- Pure integer linear programming
- Machine learning data mining & cluster analysis
- Pricing model algorithm
- Timeout reminder

Pain Point 5

Solution

Turnover box resource dispatching

Benefits

- Original cycle time: 30 days

Expected reduce to: 15 days

- "80-20" principle:

Develop and focus on high quality users

The trans...
fully loade...
but empt...
return
Low circul...
rate

...ent

...gramming
...ming &

Pricing model algorithm
Timeout reminder

Pain Point 6

- Poor path planning causing delay
- Responsibility cannot be traced

Solution

Path navigation between two points

Multi-point path planning

Demo

- Path navigation
- Optimal path planning based on genetic algorithm

Benefit

- Smart Factory
- Improve logistics level

for Bosch

--Reduce costs

Before: Labor + Packaging costs=¥820,000/1 year

After: hardware +mataining costs=¥2,800,000/5 years

Cost recovery:3~4 years

--firm cooperation based on supply chain among
Bosch ,suppliers, OEMs, retailers...

--expandable,expected smart logistics and Industry 4.0

Premise

-turnover box:600*400*280

-pallet:1200*800

-truck:28t,12.5m*2.4m*2.7m

-cycle time:10 days

for Society

- reduce waste of paper material
- environment friendly