Technical White Paper of YALATECH ESL Solution

Contents

1. Background and Introduction

This technical guide is for those who want to explore the technologies of electronic shelf labels. We delve into the multiple parts that make up an entire electronic shelf label system and walk you through it all: from the installation of a single unit to the shelf, to the consumer's physical contact with the ESL, to the back-end platform software that orchestrates it all. In this document, we not only take you to understand why electronic shelf labels reflect the value and application scenarios in today's business environment, but also take you to a deeper understanding of how electronic shelf labels work.

YALATECH has developed a wireless IoT platform consisting of hardware and software, which form a unique and revolutionary electronic shelf label system. We insist on making the cloud ESL IoT system better and better.

1.1. Electronic shelf label workflow

A complete electronic shelf label system consists of 4 main components: server, base station, electronic shelf label and mobile terminal.

First, the IPS (Information publishing system) on the server packages the content to be displayed into a data packet format, and then the IPS software immediately transmits the data packets to the base station through the network.

Once the data packets are transmitted to the base station, the base station will convert the data packets into a data format that can be displayed on the electronic shelf label and send them to the designated electronic shelf label.

In addition to publishing content information, the IPS software can also publish information such as LED flashing tasks, switching templates, monitoring data, and abnormal alarms.

After the electronic shelf label receives and corrects the data, the data content is displayed on the display screen. Each electronic shelf label has a unique identification code in order to receive information associated with it, which can be sent to all labeling devices or to a specific labeling device.

A single base station can cover 3000 pieces ESL tags, and the base station can send/receive signals within a radius of 25-30 meters.

Store employees can use mobile terminals to review and manually adjust prices and other product information at any time by scanning bar codes or NFC. The workflow process (YL-01) is as follows:

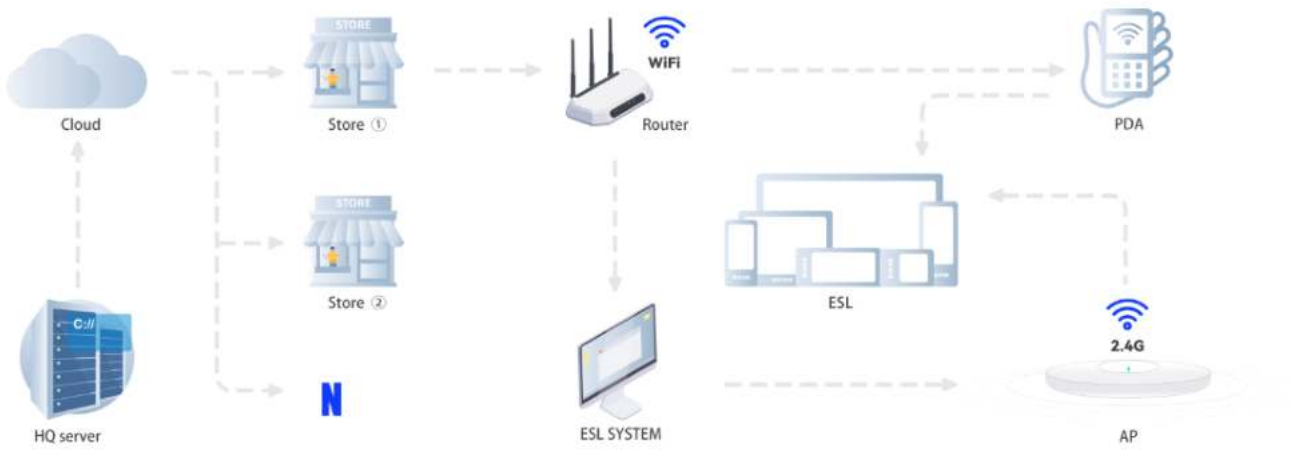


Figure YL-01

1.2 Advantages of YALATECH ESL

Our advantages lie in the following 3 aspects:

(1) Flexible deployment solutions, it support almost 98% of the deployment methods in the market, including cloud deployment, on-premises deployment and other deployment methods. At the same time, our cloud deployment is a minimalist mode deployment. The deployment is as following figure (YL-02):

Figure YL-02

(2) In house capabilities from hardware R&D, production to software development and service support. We own the core technology inventions and patents, masters a number of technologies like computer vision recognition, ultra-low power wireless radio frequency communication, new generation e-paper display technology, digital media signaling system. We are committed to the innovative R&D and processing of smart retail IoT technology, with business all over the world. As

shown in the picture (YL-03\YL-04)

Photo YL-03

Photo YL-04

(3) Industry comprehensive solutions cover a wide range, bringing multi-dimensional business value to multiple industries, especially the retail industry:

• Smart price management, making it possible for stores to analyze and adjust prices in real time based on dynamic business data;

• Cost saving, automatic price change process, paperless, reduce labor cost, save consumables, high efficiency and environmental protection;

• The headquarter controls the price, which facilitates the standardization of operation, the integration of prices, and the digitalization of chain stores;

• Refined operation, the price change process can be traced back, combined with the comprehensive analysis of the sales data of the product, to provide decision-making basis for the refined product marketing;

• New types of smart stores and unmanned retail emerge. ESL is indispensable to enhance corporate image and enhance shopping experience;

• Human-goods interaction, consumers can trace the goods by scanning the QR code of the goods on the ESL tag (the traceability source code connected to the third-party ERP system), which improves the interaction with consumers and enhances the stickiness with consumers.

2. Main technology of hardware

2.1. Anti-collision \ dust \ waterproof

The durability of the electronic price tag also directly affects the service life of the product itself. Our products are anti-collision, dust-proof and waterproof, so that they have the conditions for long-term use in retail environments. The following picture is the test report made by a third-party testing company for YALATECH, among which the slim series 4.2inch products can reach a maximum drop resistance of 3 meters, please see the picture below:

Sample Name:	YALA-ESL	
Sample No	Sample Model Number	Sample Size
1#	YLTAG-1/SLI/BWR/0750/L	5PCS
2#	YLTAG-1/SLI/BWR/0213/L	10PCS
3#	YLTAG-1/SLI/BWR/0266/L	9PCS
4#	YLTAG-1/SLI/BWR/0290/L	11PCS
5#	YLTAG-1/SLI/BWR/0420/L	10PCS
Sample Weight:	/	
Sample Quantity:	/	
Sample Description:	Normal	
Sample Supplied By:	Client	
Manufacturer:	YalaTech Co., Ltd	

Figure YL-05

Figure YL-06 Drop Test

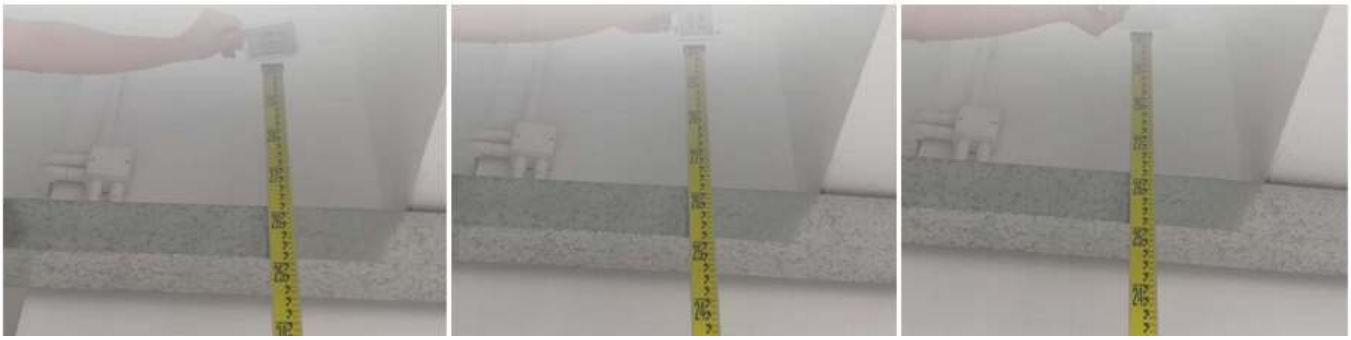


Figure YL-07 Drop Test

Figure YL-08 （1kg*m/s=9.8n）

Compressive strength of the ESL display of Rock Series, the highest compression can withstand ≈ 23kg

The Fresh Series support IP67 waterproof and low temperature, can last for 30 minutes in water, can work in -25°environment, and is suitable for a variety of usage scenarios.

Certificate of Conformity

Certificate Number: DL-20210713003C

Applicant: **YalaTech Co., Ltd**

Room 508, Building B, Xiju Center, Jianpeng Road, Helong Street, Baiyun District, Guangzhou

Manufacturer: **YalaTech Co., Ltd**

Room 508, Building B, Xiju Center, Jianpeng Road, Helong Street, Baiyun District, Guangzhou

Product: **YALA-ESL**

Model Number: **YLTAG-1/FRE/BWR/0213/F**
YLTAG-1/FRE/BWR/0266/F、YLTAG-1/FRE/BWR/0420/W

Test Standard: **EN60529:1991+A1:2000+A2:2013**

The EUT described above has been tested by us with the listed standards and found in compliance with the council LVD directive 2014/35/EU. It is possible to use IP marking to demonstrate the compliance with this LVD Directive. It is only valid in connection with the test report number: DL-20210713003S.

IP67

Manager

Jul. 13, 2021

Figure YL-09

Photo YL-10

2.2. High-resolution e-paper technology

The display color is black and white red/black and white yellow/black and white/black and white red and yellow specifications. The screen is completely sealed to prevent color fading and moisture resistance of the display.

Taking 2.13 as an example, the resolution of the old generation product is 212*104px, and the new generation reaches 250*122px, which is an upgrade of nearly 20% compared with the old generation.

• Higher resolutions result in sharper font display, allowing more content to be displayed on smaller labels

• Give your users a better experience and display content that is easier to identify. See the example below:

Figure YL-11 (The picture on the left is the old generation, the picture on the right is the new generation)

2.3. Principle of efficient work

2.3.1 Update speed

The data transmission speed of the base station increases exponentially. With this feature, you can manage prices in real-time during store hours, resulting in more sales and profits, and less food waste. Please see the diagram below

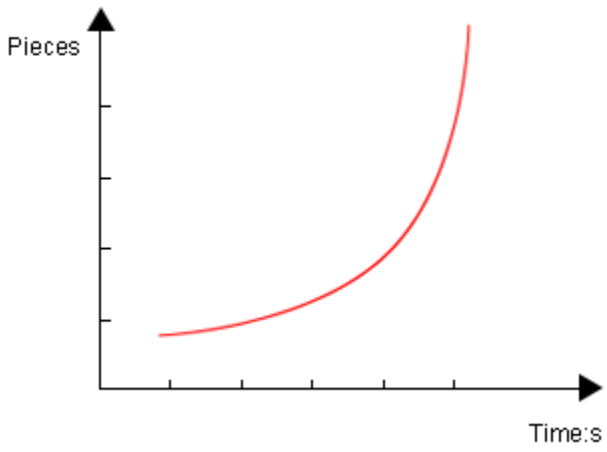
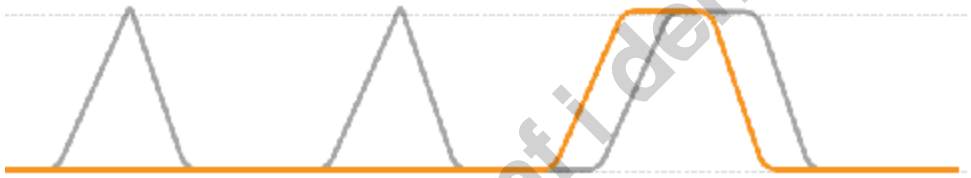


Figure YL-12

Figure YL-13

2.3.2 Millisecond Response

According to the intelligent frequency regulation algorithm, the ESL will actively predict the time when the price may change according to the daily transmission frequency of the base station, and actively wake up the sleep state to achieve millisecond-level response. Please see the diagram below



Note: Orange is awake state, gray is sleep state

Figure YL-14

2.3.3 The third generation compression algorithm

Under the premise of not sacrificing the display quality, the transmission image compression rate is as high as 70%-75%. Compared with the old generation, the file transmission efficiency is improved by more than 200%.

2.4 Ultra-low power consumption

The ESL tags actively wake up and actively request, so that they are usually in a sleep status, and wake up at a certain period. After waking up, they immediately query the server for their own update status through the base station, and if there is no update, they re-enters the sleep status;

At the same time, the ESLs, base station and server are connected by means of stateless connection and data cache, which simplifies the system structure, and the system load is evenly distributed according to the processing capacity of the device, so as to realize the efficient exchange of data, so as to achieve the effect of on-demand work. The power consumption is greatly reduced when the hardware device does not move, and the battery life of the ESL tags can be increased by about 50%.

Figure YL-15

2.5 Editable and controllable LED indicator

It is critical for the success of stores to constantly work towards improving their productivity by increasing the efficiency of employees as well as sales on the shop floor.

Flash Alert is a solution that provides store owners with a web based tool, Flash Task Manager with which they can control the flash of the ESLs: when, for how long, at what frequency and more importantly which trigger? With the Flash Task Manager, labels could flash outside of store opening hours to indicate to associates which products have a negative stock.

The Flash Alert solution enhances the shopper experience: the retailer can choose to make ESLs flash for products that are on promotion in order for shoppers to immediately find them.

Use LED lights in retail scenarios to assist shop assistants in order picking or help consumers quickly find a specific product through LED flashing. LED viewing angle is close to 180 degrees visible.

Figure YL-16

2.6 Private communication protocol

2.6.1 Zigbee Private Protocol

ZigBee wireless communication technology can achieve coordinated communication among thousands of tiny sensors relying on special radio standards. ZigBee wireless communication technology can also be used in small-scale wireless communication-based control and automation fields, eliminating the need for computer equipment and wired cables between a series of digital devices, and enabling wireless grouping between a variety of digital devices so that they can communicate with each other or access the Internet.

The main features of this technology are low power consumption, low cost, short delay, high capacity, high security, support for a large number of online nodes, support for multiple network topology, low complexity, high speed, reliability, and security.

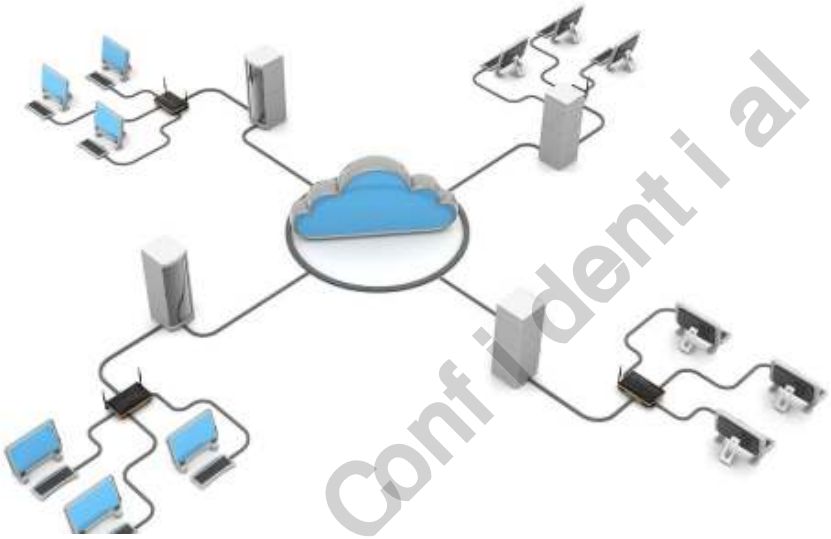


Figure YL-17

2.6.2 Multi-base station ad hoc network

When the ESL tag is re-pushed, it will be bound to the base station of the last network by default. When the base station is abnormal, the system will start the self-organizing network mechanism, start other base stations under the account, and take turns to find the closest distance to the ESL tag, and the one with the strongest signal, then complete the data push. The following figure shows the process of the entire multi-base station ad hoc network.

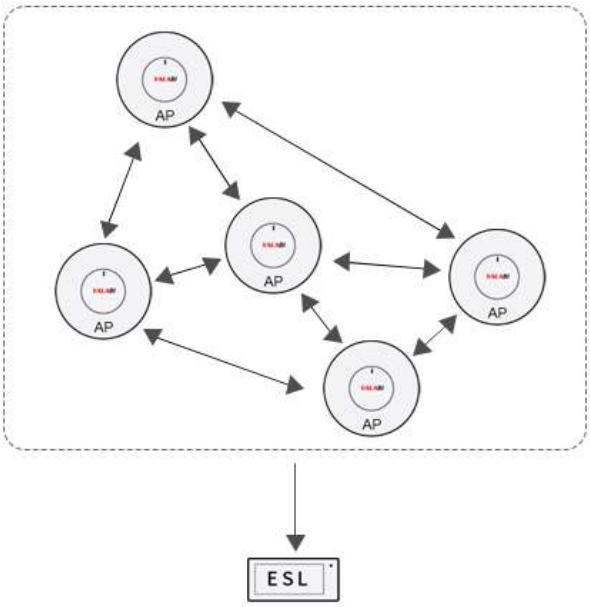


Figure YL-18

2.6.3 RF channel

The electronic shelf label is designed with 80 selectable channels, thus avoiding any potential channel collisions. Check out the two comparison charts below.

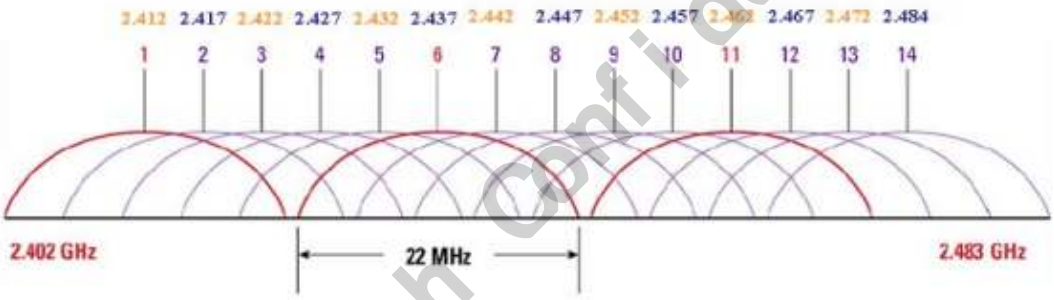


Photo YL-19（RF channel of Bluetooth and wifi）

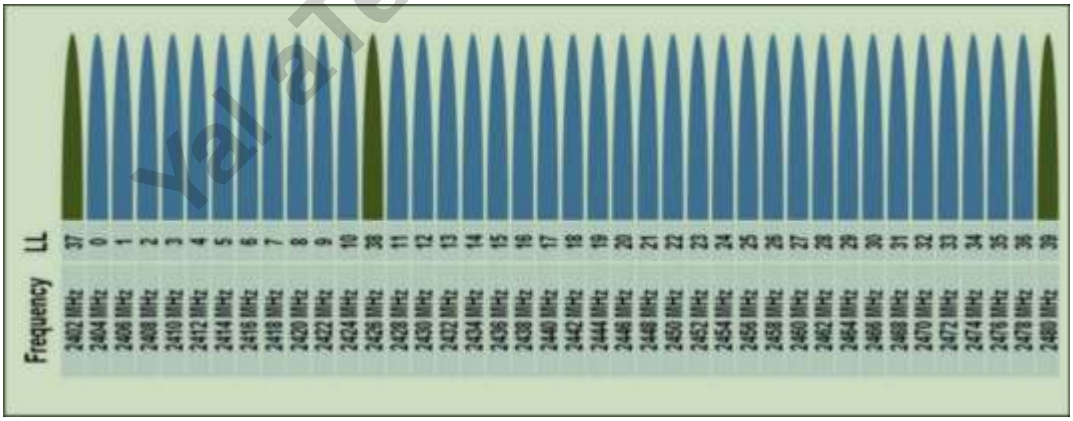


Figure YL-20（RF channel of YALATECH ESL）

2.7 NFC technology

The ESL has a built-in NFC chip, and consumers can use the mobile phone NFC to interact with the ESL tag, such as getting a coupon or viewing more product information.

Figure YL-21

Store employees can use PDA with NFC to manage ESL tags, including operations such as updating, binding and unbinding.

Figure YL-22

2.8 Four Mechanisms of Base Station

2.8.1 Broadcast Mechanism

After the base station is connected to the cloud system, once there is an instruction of data transmission, the broadcast will be started within the coverage area, and the ESL tags will enter an active state after receiving the broadcast, and receive data or instructions. This process completes the broadcast to find the price ESLs.

2.8.2 Wake-up Mechanism

The base station wakes up the ESLs through the broadcast mechanism. After the ESL receives the broadcast, it enters an active state to receive instructions or data from the base station. The self-wake-up of the ESL is based on the base station frequently waking it up at a certain time of the day, or if the update task is preset, it will wake up automatically at that time.

2.8.3 Heartbeat mechanism

The ESL is normally in sleep mode and wakes up after a certain time. The heartbeat status is changed every time the update task is performed. If the update task is not performed within 24 hours, the heartbeat status will be actively reported. The time interval at which the ESL wakes up can be changed by burning the firmware.

2.8.4 Two-way communication mechanism

The base station supports bidirectional communication between itself and the ESLs. This means infrastructure cost savings and no need to install hubs. The communication between the base station and the ESLs includes command mutual transmission, data distribution, heartbeat status, etc.

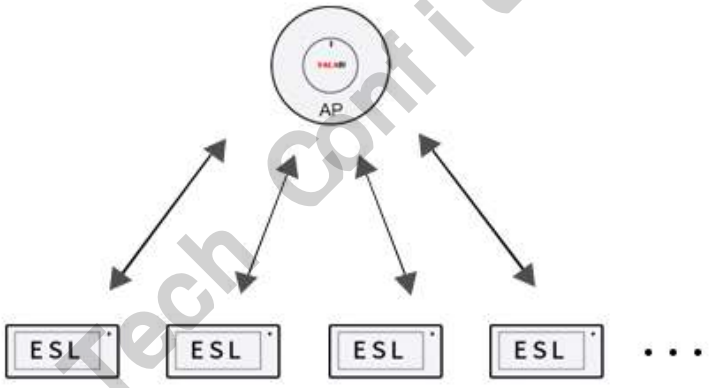


Figure YL-23

3 YALATECH ESL Cloud Platform

3.1 Basic Introduction

The main components of ESL Cloud Platform are application server, database, ESL dashboard, template editor and WebPDA application. These can cover all ESL operations and management purposes, but at the same time, it provides the most efficient way to integrate with a retailer's existing IT systems. It enables quick and easy integration with other IT solutions through its API. Please see the following instructions:

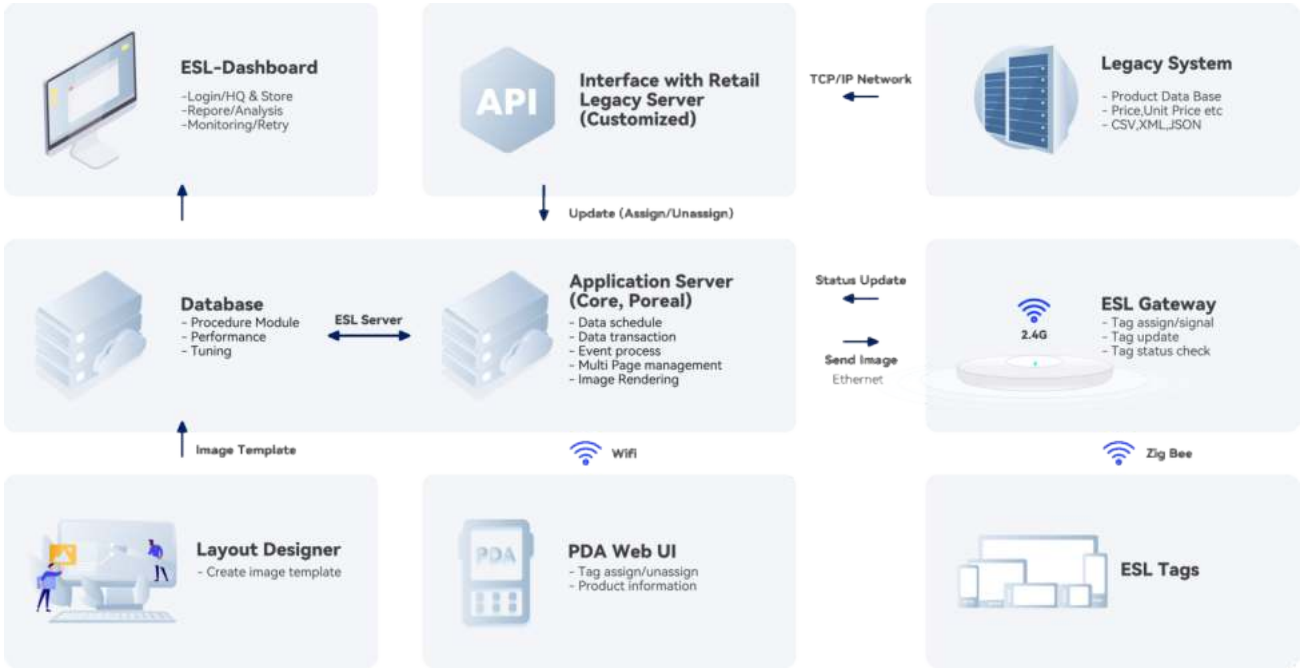


Figure YL-24

3.2 Security

3.2.1 Data Backup and Recovery

• Log backup: The system log is kept for 180 days and automatically cleared when it expires.

• Generate a temporary file: keep it for 30 days, and it will be automatically cleared when it expires.

• Database data: off-site backup, full backup every day, keep backup for 7 days, can restore data of any database or table at any point in time within 7 days.

3.2.2 Disaster Recovery

• After the database data is completely cleared, all data will be available within 30 minutes.

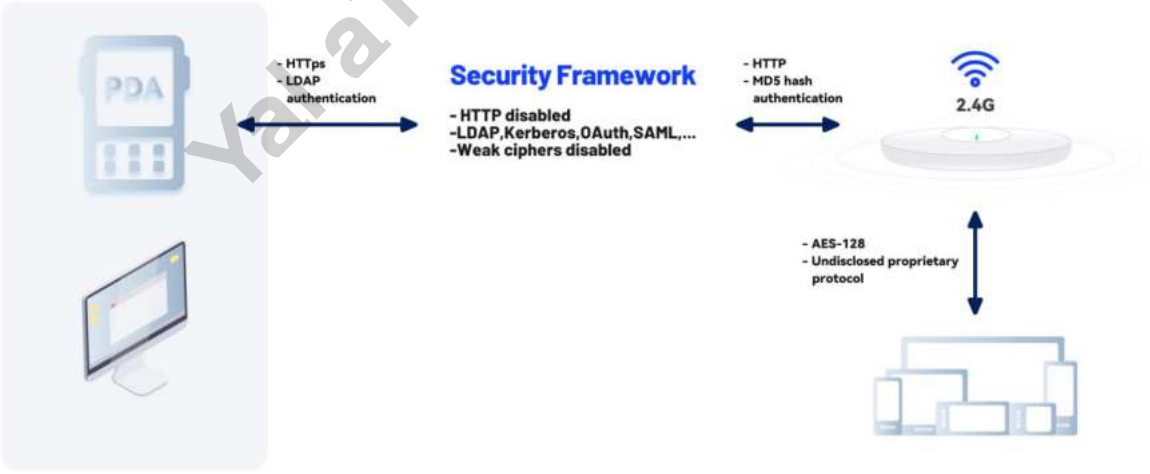


Figure YL-25

3.2.3 Downtime Handling Mechanism

• The server is built with a k8s high-availability cluster. Partial downtime will not affect the external service. If all servers are down, we will use the k8s cluster configuration file backed up in the off-site to rebuild the k8s cluster and restore the service within 1 hour.

3.2.4 Account and access control

The client account password adopts a non-plaintext transmission encryption method, and the database storage password adopts a non-plaintext storage encryption algorithm. We also provide a user management function to implement role-based access rights management for users.

3.3 Data report

Through the central dashboard of the ESL cloud platform, you can monitor the details of each ESL, such as its on/offline status, operation progress, battery status and RF signal strength, etc. You can also check the status of each base station.

Figure YL-26

3.4 Template editor

• What you see is what you get, intuitive;
• Easy to operate, can be designed without training;
• Richer definable fields;
• Can display the language of any country;
• Richer display methods and more intuitive UI interaction;

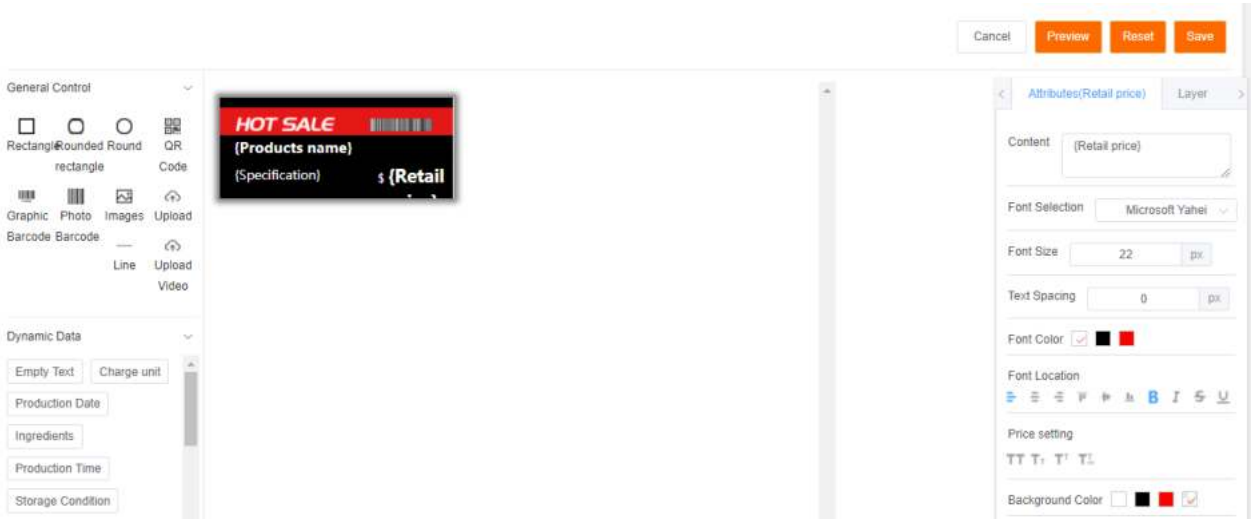


Figure YL-27

3.5 Cross-platform management

YALATECH Cloud supports android, iOS, PC multi-platform synchronization, whether you are in the office, at home or in the store, you can manage your store at any time.

Figure YL-28

3.6 Enterprise Solutions

The YALATECH ESL cloud platform can expand or contract application nodes or server nodes according to business volume. A host node can be added within 10 minutes as needed, and application nodes can be added quickly. The fault tolerance rate of server-level management nodes is 1/3, and the fault tolerance rate of worker nodes is 99%. The number of application instances will remain the configured number. If the application exits, an instance will be added automatically. If one server is shut down, all applications on the shut down server will be automatically dispatched to other servers.

The service cluster deployment is as follows:

Figure YL-29 Server cluster

Its platform has features like scalability, load balancing, parallel processing, high availability.

Load balancing: support L4 load balancing and L7 load balancing, support a variety of mainstream load balancing strategies, the default load balancing strategy is polling;

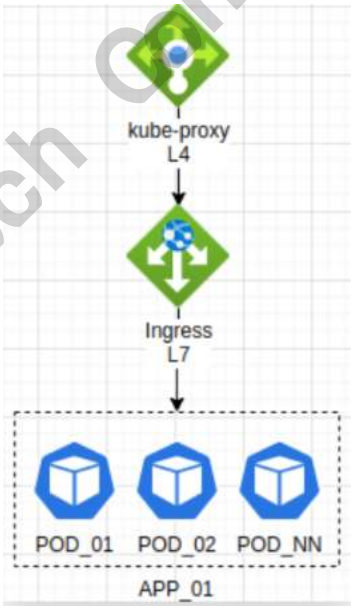


Figure YL-30

Scalable cluster: Worker nodes can be added as needed, and cluster nodes can be added as needed.

4.What’s Next

Since 2015, YALATECH has been furthering the electronic shelf label technological landscape, and helping smart retail businesses along the way. We have delivered more than 2 million ESL tags to over 500 stores and has an on-going plan to deliver 80K tags every month.

In the years to come, YALATECH will continue to innovate and create fully integrated, in-house Smart Retail solutions for every business need.