ESL Server Manual
EBSxx, EE-15x, EE2xx, EE4xx, EE7xx

User Manual

The ESL server manual describes how to demonstrate and set up the Opticon ESL solution.

v1.0.78.4

The information in this document is subject to change without notice.

Document History

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1. Features and Specifications

1.1. Abstract

This manual describes how to set-up an Electronic Shelf Labels (ESL) system with e-Paper ESLs from Opticon Sensors Europe BV.

1.2. Hardware requirements

To set-up a fully working ESL solution the following hardware is required
- EBS-40 base station (article no. 13665)
- ESLs (see chapter 1.5: Supported ESL Models)
- UTP cable (article no. 12607)
- 6.0V 2A Power supply (European; article no. 10991)
- Windows PC
    - .Net frameworks 4.6.1
    - 1GB free disk space (minimum disk size 60GB)
    - 4GB RAM memory

To set-up an ESL demo or installation the following software is required
- ESL Server installer (contains ESL server, drivers and web application)

It is recommended to also include a barcode terminal or scanner, which can be used to link ESLs to products using barcodes. Any of the following barcode terminals or scanners can be used for this purpose:
- OPH100x (+ CRD100x cradle)
- H13 (+ CRD13 cradle)
- OPL9728 / OPL9815 (+ CRD9723RU cradle)
- OPN2002/3/4/5/6 (+ mini USB cable)
- OPH300x (+ mini USB cable)
- Any handheld barcode terminal with Wi-Fi and a web browser
- Any USB-HID barcode scanner

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1.3. Supported ESL models

EE-153R

Display: e-paper b/w/r

Battery: 1x CR2450

Radio protocol: IEEE 802.15.4

Number of dots: 152 x 152

Pixel pitch: 140 dpi

Dimensions: 48.4 x 42.2 x 11.5 mm

Product number: 14460

EE-213R / EE-214R

Display: e-paper b/w/r

Battery: 2x CR2450

Radio protocol: IEEE 802.15.4

Number of dots: 212x104 (EE-213R) 250x122 (EE-214R)

Pixel pitch: 112 dpi

Dimensions: 69.9 x 34.7 x 11.5 mm

Product number: 14471

EE-293R

Display: e-paper b/w/r

Battery: 2x CR2450

Radio protocol: IEEE 802.15.4

Number of dots: 296 x 128

Pixel pitch: 112 dpi

Dimensions: 92.3 x 42.2 x 11.5 mm

Product number: 14462

EE-420R

Display: e-paper b/w/r

Battery: 2x AAA (not incl.)

Radio protocol: IEEE 802.15.4

Number of dots: 400 x 300

Pixel pitch: 120 dpi

Dimensions: 101.0 x 93.0 x 16.0 mm

Product number: 14053

EE-750R

Display: e-paper b/w/r

Battery: 4x AAA (not incl.)

Radio protocol: IEEE 802.15.4

Number of dots: 640 x 384

Pixel pitch: 100 dpi

Dimensions: 180.0 x 126.0 x 16.0 mm

Product number: 14054

EE-150R

Display: e-paper b/w/r

Battery: 1x CR2450

Radio protocol: IEEE 802.15.4

Number of dots: 152 x 152

Pixel pitch: 140 dpi

Dimensions: 45.5 x 39.9 x 14.9 mm

Product number: 13946

EE-201 / EE-202 / EE-202R

Display: e-paper b/w/(r)

Battery: 2x CR2450

Radio protocol: IEEE 802.15.4

Number of dots: 200 x 96

Pixel pitch: 112 dpi

Dimensions: 65.0 x 34.0 x 15.0 mm

Product number: 13863 / 13826 / 14315

EE-290

Display: e-paper b/w

Battery: 2x CR2450

Radio protocol: IEEE 802.15.4

Number of dots: 296 x 128

Pixel pitch: 112 dpi

Dimensions: 88.0 x 45.0 x 15.2 mm

Product number: 13841

EE-440

Display: e-paper b/w

Battery: 2x AAA

Radio protocol: IEEE 802.15.4

Number of dots: 400 x 300

Pixel pitch: 113 dpi

Dimensions: 106.5 x 90.9 x 18.2 mm

Product number: 13841

ET-350

Display: TFT

Power: 5V

Interface: Mini USB Ver. 2.0

Number of pixels: 320 x 240
(Ethernet support available using raspberry pi + USB-hub)

PE-152

Display: e-paper b/w

Power: Over rail

Radio protocol: IEEE 802.15.4

Number of dots: 152 x 152

Pixel pitch: 140 dpi

Dimensions: 48.4 x 42.2 x 10.2 mm
LED, NFC and sound feedback

Product number: 14302

PE-292

Display: e-paper b/w

Power: Over rail

Radio protocol: IEEE 802.15.4

Number of dots: 296 x 128

Pixel pitch: 112 dpi

Dimensions: 92.3 x 42.2 x 11.3 mm
LED, NFC and sound feedback

Product number: 14280

RE-294 (a.k.a. PE-292B)

Display: e-paper b/w

Power: Li-ion battery

Radio protocol: IEEE 802.15.4

Number of dots: 296 x 128

Pixel pitch: 112 dpi

Dimensions: 92.3 x 42.2 x 11.3 mm
LED, NFC and sound feedback, rechargeable on rail

Product number: 14603

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1.4. EBS40 base stations

1.4.1. Dimensions

W 145.0 x D 110.0 x H 30.0 mm (excl. antenna)

1.4.2. Weight

125 g (excl. power supply)

1.4.3. Electrical Characteristics

Parameter	Typical	Unit	Remarks
Operating voltage	6.0	V	Power adapter
Operating current	<300	mA	

1.5. Main Batteries

1.5.1. EE15x / EE2xx

The main batteries in the are 2 CR2450 Li-Mn batteries (1 for EE15x):

- Nominal capacity: 600 mAh per battery

- Nominal voltage: 3V

- Low voltage: Less than 2.8 V

- Operating time: >5 years (default settings; 15-25° C)

- Display refreshes/day (EE15x: 1/day; EE2xx: 4/day)

1.5.2. EE4xx

The main batteries in the are 2 AAA batteries:

- Nominal capacity: 1000 mAh

- Nominal voltage: 3V

- Low voltage: Less than 2.35 V

- Operating time: >5 years (default settings; 15-25° C)

- Display refreshes/day: 4

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1.5.3. EE7xx

The main batteries in the are 4 AAA batteries:

- Nominal capacity: 2000 mAh

- Nominal voltage: 3V

- Low voltage: Less than 2.35 V

- Operating time: >5 years (default settings; 15-25° C)

- Display refreshes/day: 4

1.5.4. Battery life time conditions

The operating time of the batteries is based on a realistic estimation of any of the following factors that influence the battery life:

Factor	Default values and estimated averages	Correlation * (Higher is better)	Influence
Polling for data & reporting settings	Interval: 20 seconds (EE2xx); 30 seconds (EE15xx) Retransmissions: 10% Report ratio: 1 to 39	Yes No Yes	61%
Display updates	See above	No	20%
Temperature	15-25° C	Yes	20%
Out of range / base station OFF %	Not connected: 2% Number of channels: 5	No No	4%
Sleep time	99,9%	Yes	9%
Battery self-discharge	1% / year	No	6%

* The correlation shows whether increasing the listed value increases or decreases the power consumption of the ESLs.

For example:

- Increasing the poll interval lowers the power consumption

- Turning off the base stations increases the power consumption

- A low operating temperature increases the power consumption

- More display updates per day increase the power consumption

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1.6.   Hardware Specifications

Items		Specifications
CPU	Type	Stellaris LM3S9B96 (EBS-30) Cortext-M4F TM4C129 (EBS-40) CC2530-F256 (EE29x / EE4xx / EE7xx) CC2533-F96 (EE15x / EE2xx)
	Internal ROM	256 KB (EBS-30) / 512 KB (EBS-40) 256 KB EE29x / EE4xx / EE7xx) 96 KB (EE15x / EE2xx)
	Internal RAM	96KB (EBS-30) / 256KB (EBS-40) 8 KB (EE29x / EE4xx / EE7xx) 6 KB (EE15x / EE2xx)
	External RAM	8MB (EBS-30 / EBS-40) N/A (EE200) N/A (EE201)
	Clock frequency	80 MHz (EBS-30) / 120MHz (EBS-40) 32 MHz (EE20x)
Communication	Ethernet	10/100 Mbit
	Frequency	2.4gHz
	Protocol	IEEE 802.15.4

1.7.   Serial Number

1.7.1.   EBS-30 / EBS-31 / EBS-40
The serial number can be found on the back of the base station. The base stations also have a unique MAC-address which is used for both Ethernet and radio communication.

1.7.2.   ESLs
The serial number of the ESLs is based on the 16 hexadecimal digits MAC-address of the RF-module.

However, the first 6 or 9 digits of the MAC address have been replaced by a letter.

- 'B' (instead of '3889DC' or '3889DC000')

The default barcode that is shown on the display of the ESL is identical to the bar code on the back of the ESL.

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1.8.   Safety

Handle this product carefully. Do not deliberately subject it to any of the following.

1.8.1.   Shock

Do not throw or drop the devices

1.8.2.   Temperature Conditions

Do not use the devices at temperatures outside the specified range.

Do not pour water on the devices.

Do not throw the devices into the fire.

Do not forcibly bend the cable at low temperatures.

1.8.3.   Foreign Materials

Do not immerse the devices in liquids.

Do not subject the devices to chemicals.

1.8.4.   Other

Do not plug/unplug the connectors before disconnecting the power.

Do not disassemble this product.

The device may be damaged by power surges

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2. Solution overview

Various solutions are currently supported by the ESL server application, which are listed below and described in more detail in chapter 7.
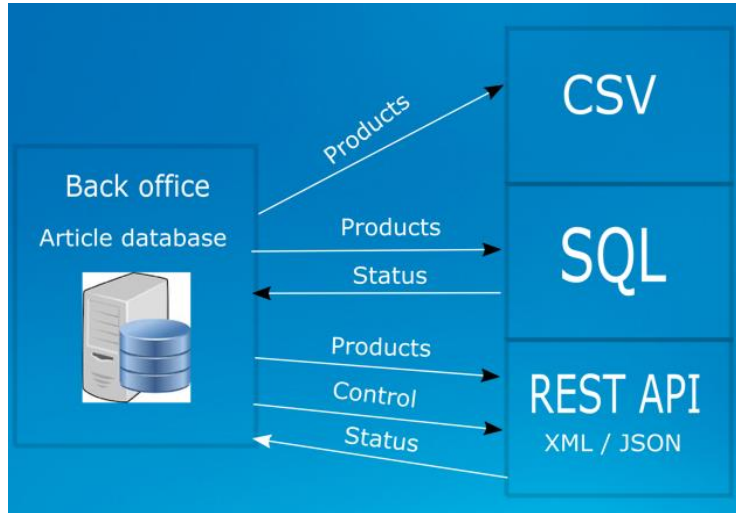
- **CSV-file solution**. The CSV-file based solution operates by running the provided ESL server application that monitors an input folder in which CSV-files, containing the product and link databases, are being placed by a back-office system. Logging is done in an SQLite database file.
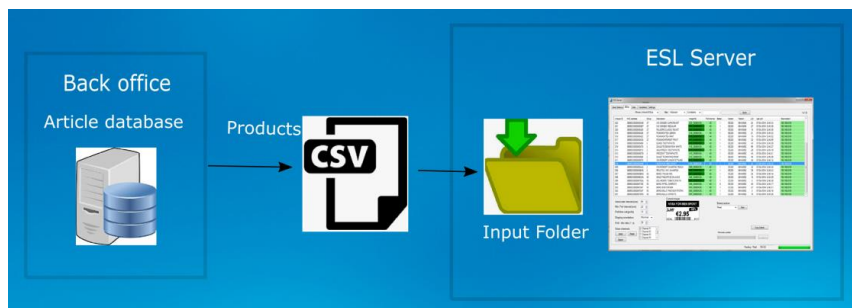
- **SQL solution**. The SQL-based solution (MS-SQL, MySQL, Oracle, SQLite, PostgreSQL, FireBird or DB2) provides the possibility to monitor and control multiple stores using one central of multiple local SQL databases in combination with the provided web application. The local ESL server application monitors an SQL database using staging tables and processes them and inserts status information of all ESLs into the SQL database. Optionally an ODBC data source can be used to connect using a DSN of an SQL database.

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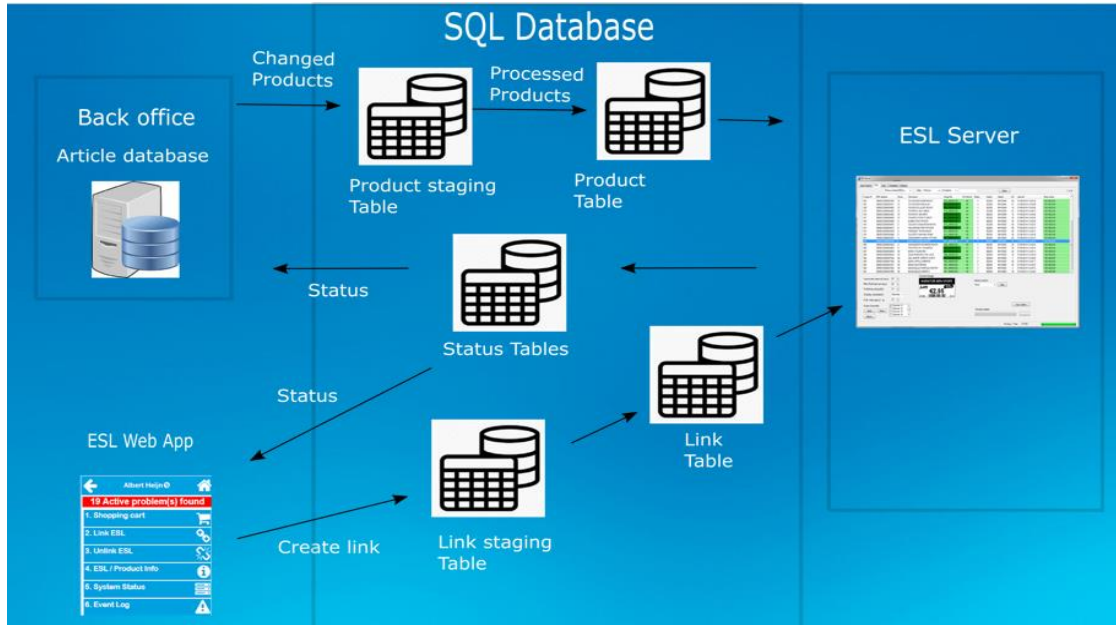
- **CSV / SQL hybrid solution**. Uses the provided ESL server application that monitors an input folder in which CSV-files, containing the product and link databases, are being placed by a back office, but inserts status information of all ESLs into a local SQL database to allow remote monitoring of the ESL system.

- **External content management solution**. Allows the connecting of an existing content management system to the ESL server. Pre-generated images are placed into an input folder, which are automatically processed and send the corresponding ESLs. Logging of status information can be done by SQL if desired.

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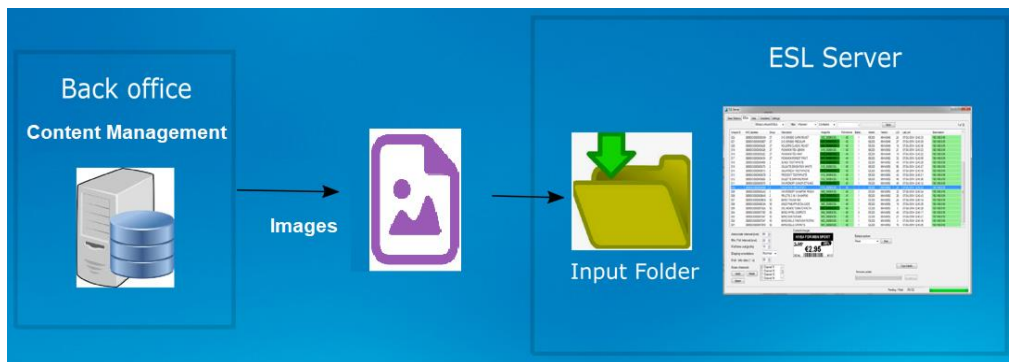
- **SQL API**. The ESL server has a SQL API, which can be used to create your own (web) application by executing SQL queries to control and monitor the ESL system, while running the ESL server as background service.

- **REST API**. The ESL server has a REST API, which can be used to create your own plat (web) application using HTTP web requests to control and monitor the ESL system, while running the ESL server as background service.
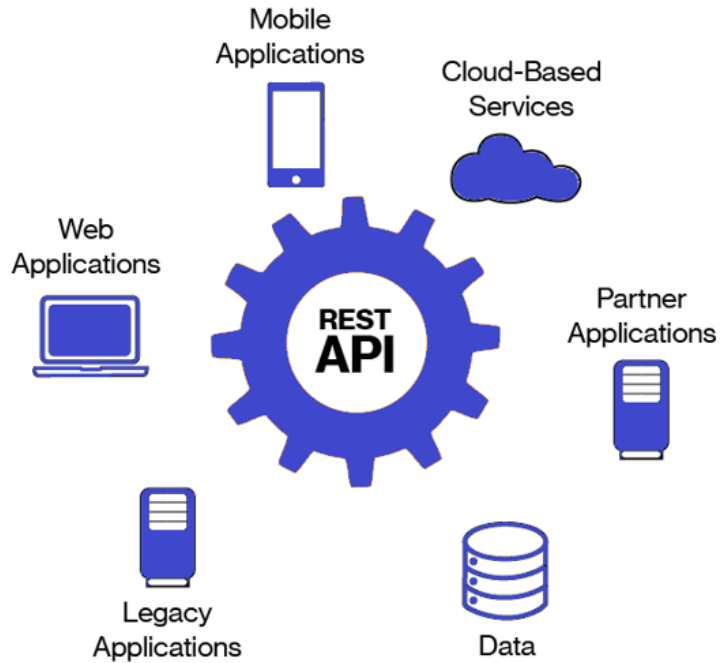
2.1.   CSV-file based solution

The CSV-file based solution operates by running the provided ESL server application that:

- Monitors an input folder in which CSV-product databases are being placed by a back office and processes them (optionally with pre-processing by a middleware application).
- Controls, monitors and configure ESLs and base stations
- Allows manual editing of product and link data bases
- Creates/changes image templates, generates the images and sent them to the ESLs
- Processes linking information from a handheld Wi-Fi barcode device or batch scanner
- Stores log and status information into a local SQLite database file
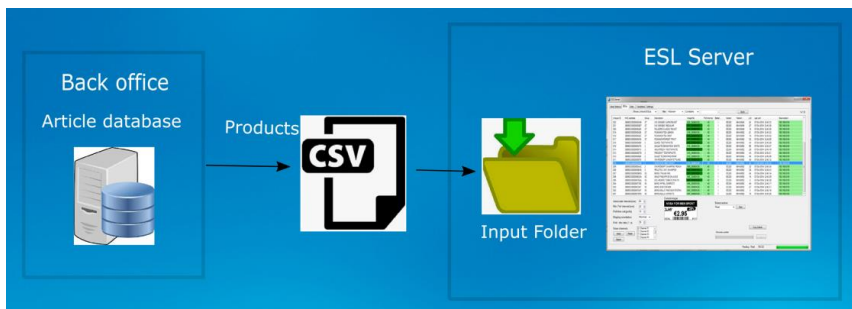
A global overview of this solution is shown below. The following chapters will describe the different parts of this system in more detail and how to get started.

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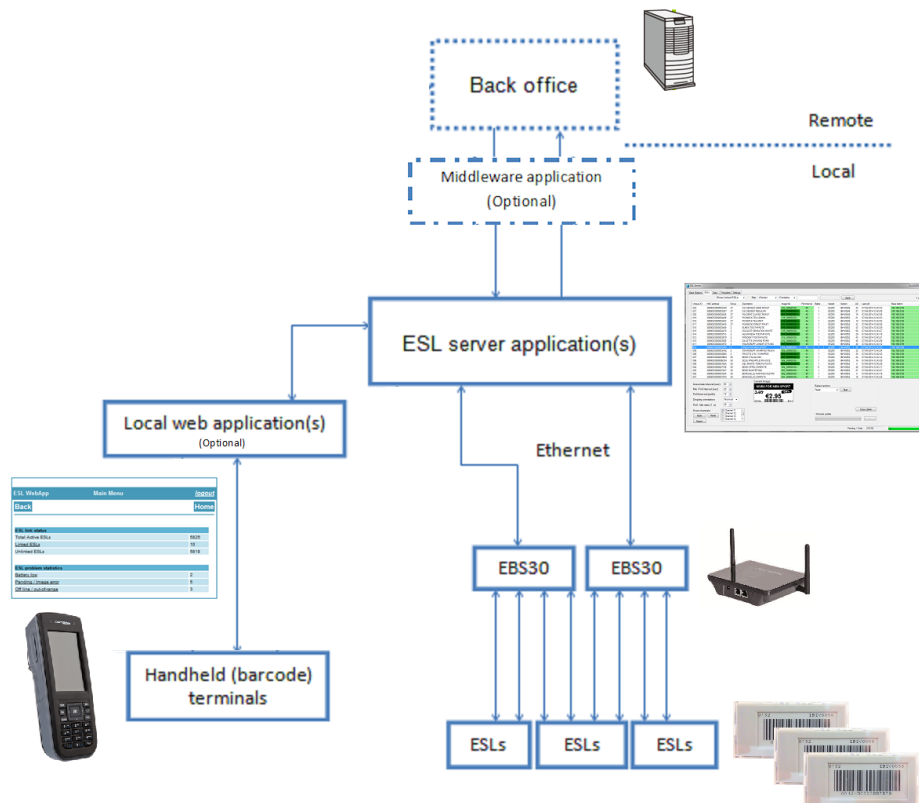
2.2.   SQL Solution

The SQL-based solution provides the possibility to monitor and control multiple stores using one central or multiple local SQL databases in combination with the provided web application.

The local ESL server application(s) will:

• Monitor a local or central SQL database using staging tables and process them.
• Inserts status information of all ESLs into the SQL database
• Controls, monitors and configures ESLs and base stations
• Allows manual editing of product and link data bases (optional)
• Creates/changes image templates, generates the ESL images and sent them to the ESLs
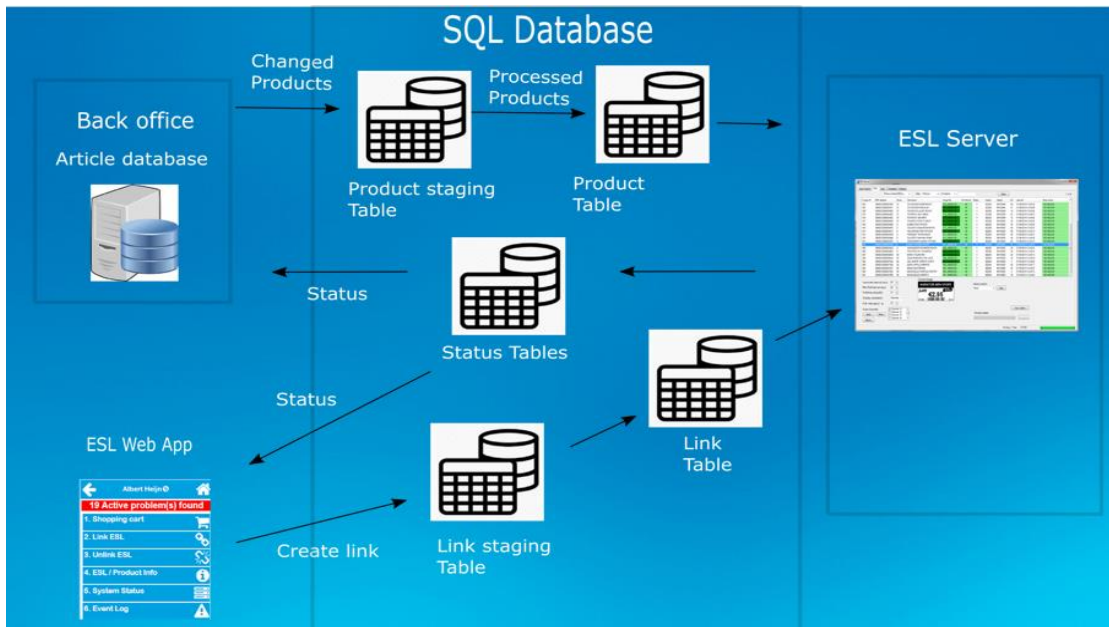
The web application can be added to provide remote and in-store control over the ESL system.

A global overview of this solution is shown below. The following chapters will describe the different parts of this system in more detail and how to get started.
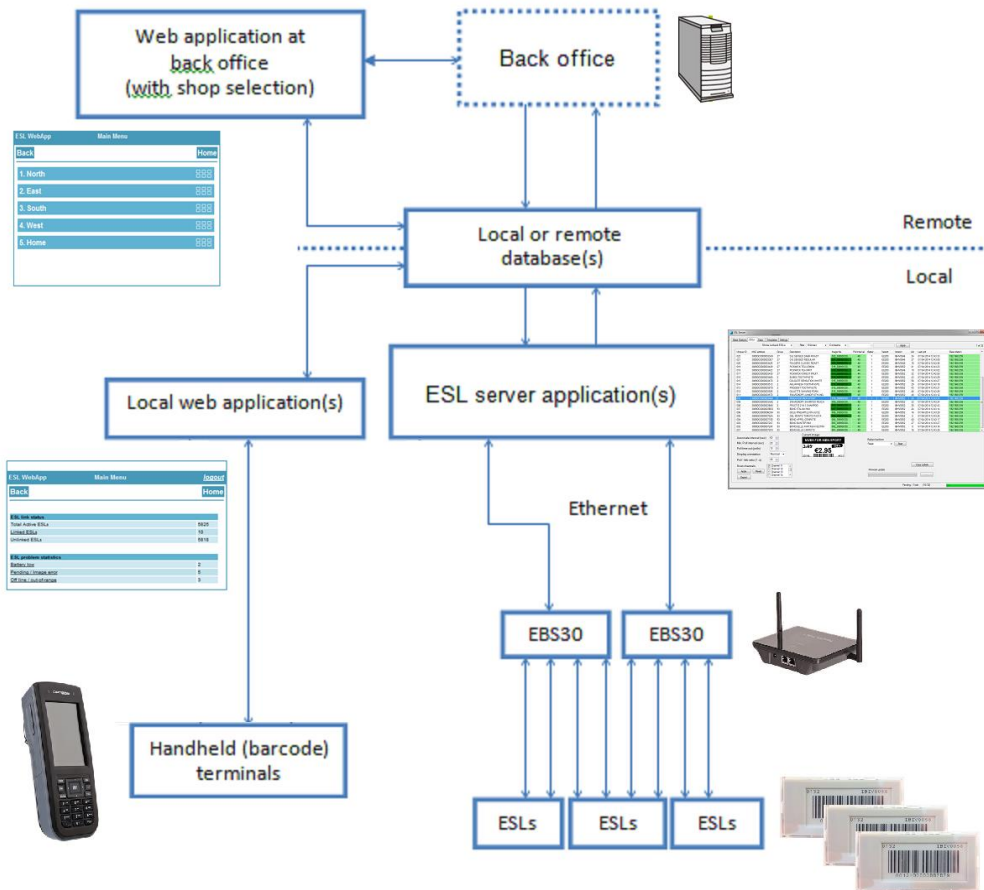
2.3.   CSV / SQL hybrid solution

The CSV / SQL hybrid solution matches the CSV-solution with the only difference that all status information on the ESLs and base station are logged into a local SQL database which can be retrieved by the back-office system. See chapter 7.4 for more information.

2.4.   External content management solution

When using external content management solution, the back office or content management system handles the generation of the images and the linking of products to ESLs.

The ESL server application basically only monitors an input folder for new images and distributes them to the corresponding base stations / ESLs.
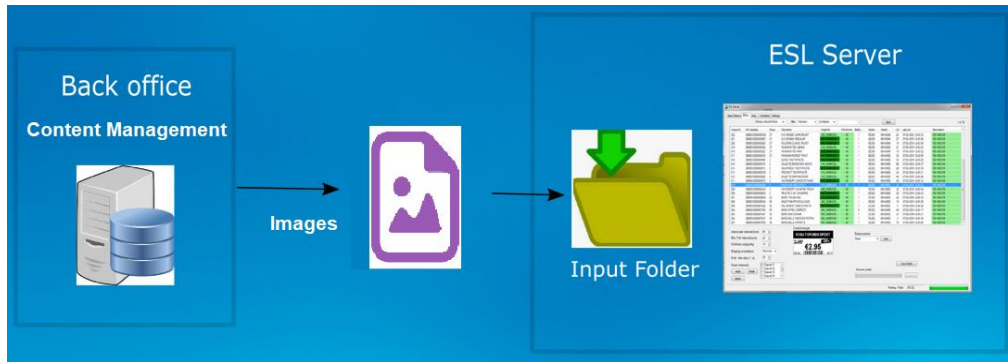
Status information will be logged into a local SQL database. See chapter 7.5 for more information.

2.5.   SQL API / REST API

The ESL server has an SQL based API and well as a REST API

2.5.1.   SQL API

SQL queries can be used as API to create your own (web) application by executing SQL queries to control and monitor the ESL system, while running the ESL server as background service.

See chapter 7.2 for information on how to use the SQL product and link staging tables to link and update ESLs and use the status tables to monitor the ESL system.

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See chapter 12 on how run the ESL server as service.

See Appendix J: Using the SQL API for more information on this API.

For maximum flexibility the SQL API can also be used in combination with the CSV/SQL hybrid solution and with the external content management solution.

2.5.2. REST API

The ESL server has a web service with a REST API that can be enabled to control the ESL system locally or remotely using your own application.

The enable this feature, go to the Settings-tab, select Web Service / REST-API and check the 'Enabled' checkbox and then press Apply.

The output format can be configured as XML or JSON as desired.
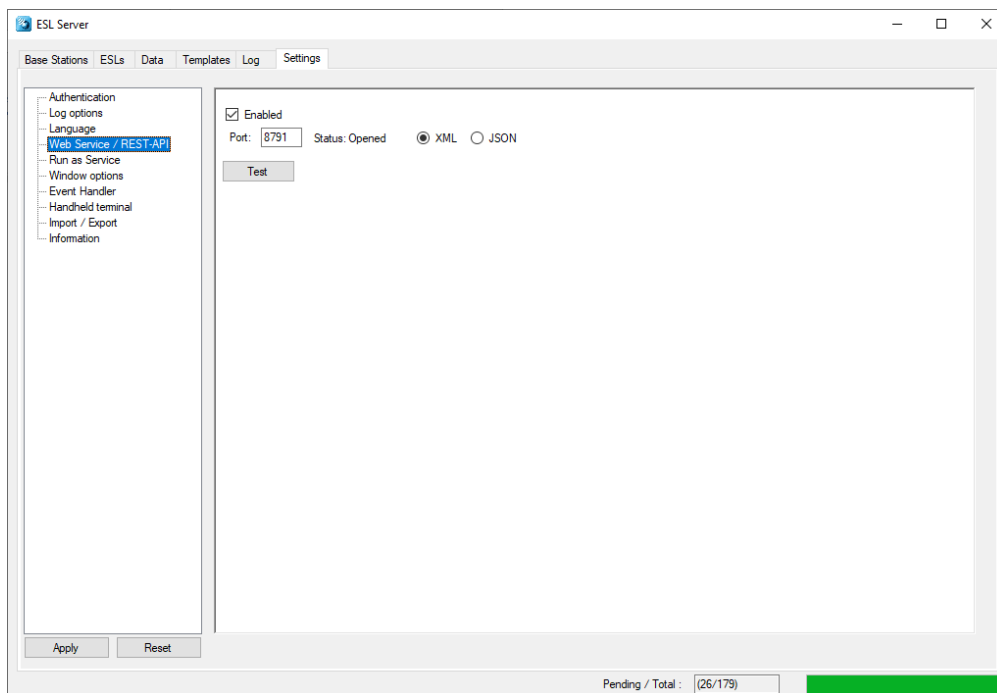
Depending on your PC settings, you may need to launch the ESL server as administrator to start the web service.

Alternatively, you can reserve the URL: http://localhost:8791/ using 'netsh' in a command prompt with administrator rights:

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netsh http add urlacl url=http://+:8791/ user=<Compute name>\<User>
(use the 'whoami' command to find your computer/username)

After launching the ESL server with the web service enabled, you should now be able to use any web browser to check the status of all base stations and ESLs.

See Appendix K: REST API for a complete overview of all REST API commands.

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3. Setting up the hardware and software

The following pieces of hardware and software that will have to be installed to get an ESL demonstration or pilot up and running:

- The ESL Server installer containing:
  - The ESL server application
  - The ESL Web application
  - Example database files and image templates
  - Firmware for the barcode terminal, base station and ESLs
  - Appload (optional)
  - USB drivers for the barcode terminal cradle (optional)
  - User manual
- 1 EBS30 / EBS40 Base station(s) that includes:
  - 6V Power supply
  - Ethernet cable
- A number of Opticon e-paper ESLs

To be able to quickly link ESLs to products using barcodes, you can use the following options:

- USB-HID barcode scanner (connected to the ESL server or by using the local web application)

- OPH1004, H13, OPN2006 or OPH300x barcode terminal (incl. communication cradle/cable)

- H21, H22, H28 or H32 using Wi-Fi (requires a local web server running the provided web application)

3.1. Installing the ESL Server application

To install and run the software you will also need a PC or Server running Windows with .NET Framework 4.61 or higher (Windows 10 recommended)

Before installing the software, make sure you have administrator rights and the PC is fully updated with all Windows updates.

If your PC doesn't have .NET Framework 4.6.1 (or higher) installed, it will be installed during the installation of the ESL Server application.

Run the installer by starting the 'SetupEslServer.msi' file.

Select the components that you wish to install. If you haven't installed Appload or the Opticon USB drivers on your PC before, make sure you install those components as well.

If you wish to use the REST-API make sure you enable the Web Service

If you wish to use the ESL Web application, make sure you enabled the installation of XAMPP (if you haven't installed Apache or MySQL on your system already)

3.2.   Installing and finding the EBS3x / EBS40 base stations

The base station can easily be installed by powering it up, connecting it to the Ethernet with DHCP support and placing it within 10 meters (the actual maximum range is bigger) of your ESLs. The PC will need to be connected to the same LAN, so it can communicate with the base station*.

After starting the application for the first time, no base station will be available to communicate with ESLs.

Press the 'Find' button on the 'Base stations-tab to find the connected base station.
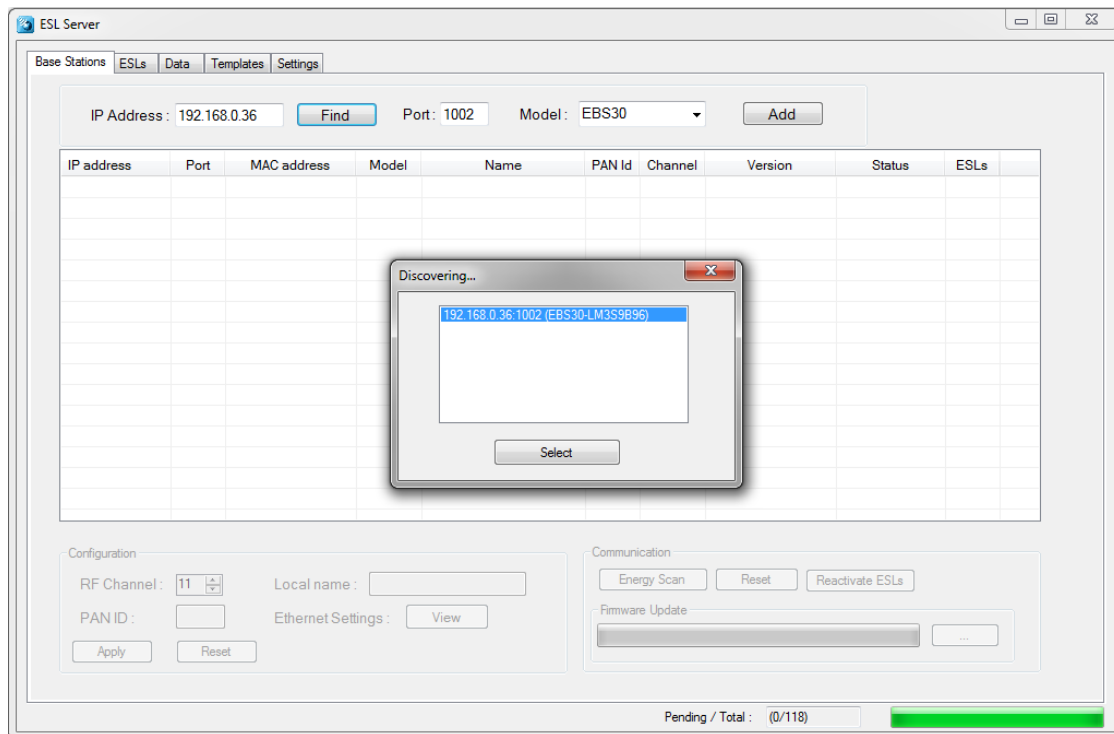
Select the discovered base station to add and connect your PC to the base station*.

If activated ESLs are nearby, then the ESL count will start incrementing as they start connecting to the base station. However, if the ESLs are still 'deactivated', they will first have to be reactivated.

* Note 1: when the base station is connected to the LAN with DHCP the IP address can vary over time, making it necessary to remove the old base station entry by pressing the 'Delete'-key of your keyboard and discovering the base station again using the 'find' button. Using static IP leases in the DHCP server can resolve this problem.

* Note 2: when the base station is connected to the LAN without DHCP, the default IP address/subnet mask of the base station is **169.254.19.63 / 255.255.0.0**. Configure a PC or laptop on the same subnet to change this using a web browser.

3.3. Installing and activating the ESLs

On arrival the ESLs already have their batteries inserted.

However, to allow safe transport by airplane, it is likely that the ESLs will show a 'DEACTIVATED' message in their left top corner. This means the ESLs do not emit any radio signals and won't be searching for base stations at this point.

To reactivate these ESLs place them nearby the connected base station and select the base station in the list view of the 'Base stations'-tab. This allows you to press the 'Reactivate ESLs' button in the bottom right corner.

After pressing this button, a dialog will appear showing a progress bar and how many ESLs have been reactivated so far.

Since the ESLs will only wake-up for a split second every few minutes, it can take more than 15 minutes before all ESLs have been successfully reactivated. You can verify this by checking whether the 'DEACTIVATED' message has disappeared from the screen.

Active ESL's will periodically search for an Opticon base station, so as soon as an Opticon base station is within range, they will associate with it and start sending data requests and status information to it. When a base station is turned off or an ESL is moved out of range, an ESL will time out after a couple of minutes and starts seeking for another base station in range. See chapter 6.1 for more information about configuring ESLs.

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It might be possible that even though the ESLs are working properly, they still don't connect to the base station. This might be caused by strong interference on the default RF-channel of the base station. To resolve this problem, see chapter 5.1

3.4.   Mounting ESLs

Since there are many types of mounting clips to mount shelf labels to shelves, the ESLs of the demo kit are supplied without mounting clips. Please contact Opticon for more information on the mounting possibilities of our ESLs to your shelves. For simple demonstration purposes with small amounts of labels one might also consider using double sided foam tape as a temporary solution.

4. Linking of ESLs to products

Linking of ESLs is the process of telling the system which product should be shown on which ESL. This is usually done by scanning the MAC address bar code on the ESL label followed by scanning (or entering) the unique ID of the product.

The unique ID can be anything: an EAN code, article number, location, room number, etc. As long as it's a unique identifier in the database, it can be linked to an ESL.

Opticon provides 3 methods for linking ESLs to products in your product database.

4.1. Using the ESL server application

(Link manually or by using a barcode scanner)

- **Advantage:** Linking ESLs in the ESL server application requires no additional hardware. This makes it ideal for demonstration purposes and small installations.
- **Disadvantage:** The ESL server usually isn't located right next to the products and ESLs in a store, which makes scanning both the ESLs and products and time-consuming process

4.2. Using the provided web application

(requires a handheld terminal with web browser & Wi-Fi)

- **Advantage:** Linking of ESLs using a web application is quick and can be done everywhere in the store with almost all handheld barcode devices (if it has a web browser and Wi-Fi). ESLs will immediately start updating after linking.
- **Disadvantage:** Requires that the Web application is installed using an HTTP-server (like Apache) and to be available on the Wi-Fi network.

4.3. Using an Opticon batch terminal

- **Advantage:** Linking using a batch terminal is quick and can be done everywhere in the store and without any wireless connection.
- **Disadvantage:** It requires an Opticon batch terminal, which needs to be moved back to the ESL server to upload the created link information. ESLs won't start updating until the batch terminal is connected to the ESL server PC.

The following 3 chapters will describe these 3 methods in more detail.

4.4. Linking in the ESL server application

Linking in the ESL server application can be done manually and by using any USB-HID barcode scanner.

Hint: Using a USB-HID barcode scanner is quick and avoids human error.

To (un)link an ESL, either select the ESLs-tab of the ESL-server and double click on an ESL that needs to be (un)linked and then type, scan or find a product in the product database and then press apply.

Or select the 'Data'-tab and press the 'Add' button or double-click on an existing link and then type, scan or find the MAC address of the ESL and the product ID.
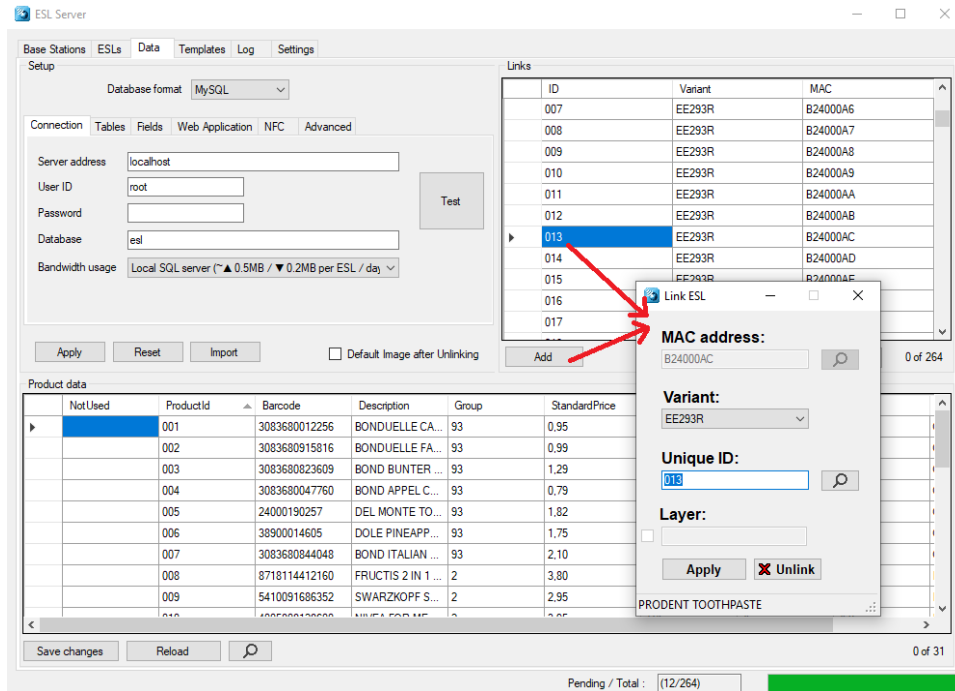
When using an USB-HID scanner, this can be quickly done by scanning the MAC address bar code on the ESL label followed by scanning the unique ID or barcode of the product.

## 4.5.	Linking using an Opticon batch terminal

Opticon provides software for a wide variety of batch terminals to perform this task. The following bar code terminals are currently supported:

- OPN2002/5/6 (bar codes only; uses a mini-USB cable)
- OPH1004 (bar codes & keypad; requires a CRD1001 cradle)
- H13 (bar codes & keypad; requires a CRD13 cradle)
- OPL9728 (bar codes & keypad; requires a CRD9723RU cradle)
- OPH300x (bar codes & keypad; uses a mini-USB cable)

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More information on how to set-up the barcode terminal can be found in chapter 10.

4.6. Linking using the provided web application

Using Opticon's H21, H22, H28, H32 or any other Wi-Fi terminal it is possible to link ESLs to products and monitor the ESL system using a Wi-Fi connection. This is done by installing a local webserver that runs the provided web page to perform the linking.

For large installations this is the ideal solution, because it's quick, can be done in the store, ESLs will immediately start updating after linking and it contains multiple monitoring options to check the status of all ESLs, products, base stations and the ESL server.

Using and setting up the web application is described in more detail in chapter 11.

5. Configuring the base stations

Base stations have very few configurations besides the configuration of the Ethernet settings (which will be described in chapter 5.4). The only vital configuration is the RF channel on which the base station operates.

5.1. Configuring the RF channel

The base station operates on a single RF channel, which can be selected in a range of channel 11 to 26 (as specified by the IEEE 802.15.4 standard).

When using multiple base stations, it's strongly recommended to use a different RF channel for each base station within range to improve the maximum throughput of data and reduce data collisions.

Since the base station / ESLs, which apply the IEEE 802.15.4 standard, operate on the same frequency band as i.e. WIFI and Bluetooth it's important to make sure that a base station does not operate on the same RF channel as any nearby WIFI network to minimize interference.

To detect which RF-channels are least active, the base station can perform an energy scan on all 16 available channels and graphically show the energy levels in a real-time graph.

To check the energy levels on the RF bandwidth, select the base station in the 'Base stations'-tab and press the 'Scan' button.
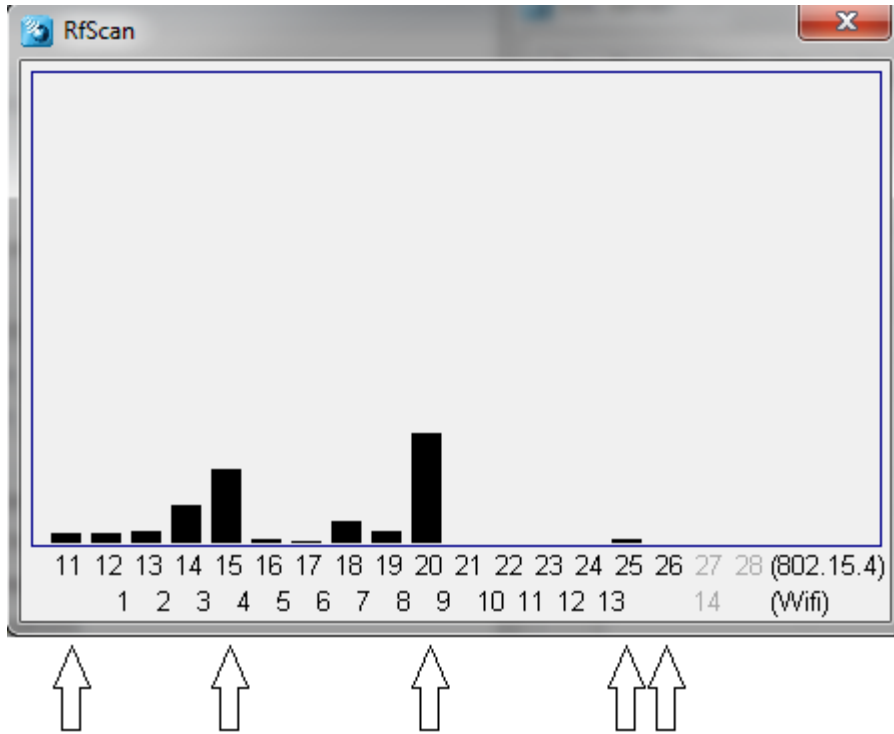
Since the EE201 ESLs will (by default) only look for base stations on **channels 11, 15, 20, 25 & 26**. Look for the RF channel with the lowest energy level (on average) of these 5 channels.

If the RF channel of the base station is set to a channel outside this selection, the ESLs will not find the base station. If you do wish to use any of the other channels, then it's necessary to first configure a different RF channel selection into the ESLs before configuring the base stations. (See chapter 6.1.6)

Note: If an ESL is not associated to any base station and its RF channel range is unknown, then configure a base station to **channel 11**. This channel will always be scanned by an ESL to make sure they can always be found and reconfigured without having to look for it on all channels.

After determining the least active RF-channel, close the RfScan-dialog. After that you can change the 'RF Channel' in the 'Configuration' section of the 'Base stations'-tab and press 'Apply' to confirm.

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After the RF channel is changed, the base station will automatically reset to apply the new setting.

Be aware that any ESLs that were already associated with the base station before changing the RF channel will lose their connection with the base station. By default, it will take 30 polls (times the poll interval of 20 seconds) before the ESLs will time out and start looking for another base station.

To avoid having to wait a couple of minutes before the ESLs start looking for the base station on the new RF-channel it's possible to disassociate all the ESLs from the base station prior to changing the RF channel. To do so, select all ESLs in the 'ESLs'-tab that need to be disassociated, then select the 'Kick from base station' action and press the 'Start' button. All ESLs should now start disassociating from base station. Once they're all gone, quickly change the RF channel and the ESLs should start to reappear again on the new channel.

5.2. Changing the local name

To make it easier to distinguish multiple base stations, it's possible to assign a name to base stations. This can be done by editing the text field besides 'Local name' and pressing the 'Apply' button afterwards to store the name inside the base station.

5.3. Changing the PAN ID / LAN ID

Base stations are addressed by the ESLs by their PAN ID (2 bytes) and a 16-bit LAN-ID.

The **PAN-ID** makes it possible to have multiple base stations operating on the same RF channel. By default, the PAN ID is the same as the 2 least significant bytes of the MAC-address. In the extremely rare case that you will have two base stations that have the same default PAN ID, it's necessary to change the PAN ID manually. In this case, edit the PAN-ID to a unique 4-digit (hexadecimal) value and press the 'Apply' button afterwards to store the name inside the base station.

The **LAN-ID** makes it possible to run two or more parallel ESL networks next to each other. By default, the LAN-ID is 0000, which means any Opticon ESL will connect to this base station. To run two ESL networks in parallel, change the LAN-ID of both networks to non-zero.

Do this by configuring the LAN-ID of all base stations of both networks. Then make sure the LAN-ID of all ESLs is cleared (=default), by using the ESL action: 'Clear LAN Id'). Then move all ESLs to a base station of the desired LAN-ID. Once all ESLs are associated to the correct network, choose the ESL action 'Set LAN Id' to lock the LAN-Id of the ESLs.

Be aware that any ESLs that were already associated with the base station before changing the PAN-ID or LAN-ID will lose their connection with the base station. By default, it will take 10 or 20 polls (times the poll interval of 20 seconds) before the ESLs will time out and start looking for base stations again.

5.4.   Configuring the Ethernet settings

By default, the base station is configured with DHCP enabled. If DHCP is not available, then the EBS-3x / EBS-40 will be available on the following IP address and subnet mask: **169.254.19.63 / 255.255.0.0.**

If DHCP is used, make sure the DHCP server always leases the same IP to the same base station to prevent having to find and add the base station again every time that the IP-addresses changes.

To change the Ethernet settings, you first have to find and add the base station in the 'Base stations'-tab of the ESL server application. After that, you can open the embedded webpage of the base station with your default web browser by pressing the 'View' button next to 'Ethernet settings'.

It's also possible to access this webpage directly from your web browser using the IP-address of the base station.

After that you can change all the settings of the base station by going to the 'Configure' page.

Important notes:

- If DHCP is disabled and the current IP address and subnet mask are unknown, then it's possible to recover the EBS-3x/4x by applying power the device with the reset button pressed. This will re-enable DHCP temporarily to allow reconfiguration on a network with DHCP enabled.

- If DHCP isn't available or working, then it's possible to connect the base station directly to the Ethernet port of your PC with the following IPv4 set-up: 'Obtain IP address automatically disabled; IP: 169.254.19.61; Subnet: 255.255.0.0. After that the base station can be discovered and configured on the default IP-address: 169.254.19.63 using the configuration webpage.

- Do not use a Wi-Fi connection to connect your ESL server to the EBS-3x/4x's to ensure a reliable connection.

- The default password of the configuration page is 'admin'.

- The base station can also be controlled over the Internet or via a public network, but it won't be a secure solution, since SSL isn't supported yet in this SDK nor is the webpage password protected.

5.5. Factory default

To set the base station back to factory default, apply power with the reset button pressed and keep it pressed for 15 seconds. This will re-enable DHCP and set the IP address and subnet mask back to the default values: 169.254.19.63 / 255.255.0.0. Also, the other configurations will reset to factory default.

Important: If DHCP is disabled and the current IP address and subnet mask are unknown, then it's possible to recover the EBS-3x by applying power the device with the reset-key pressed. This will re-enable DHCP temporarily to allow reconfiguration of the base station on a network with DHCP enabled.

5.6. Base station firmware update

The latest firmware is always included in the latest ESL server application, which can be downloaded from our FTP:

ftp://ftp.opticon.com/pub/ESL/

You can upgrade the firmware by selecting the base station in the base station-tab of the ESL server application and pressing the firmware update button on the bottom right.

The firmware file for the base station can be found in the 'firmware' folder of the installation directory of the ESL server.
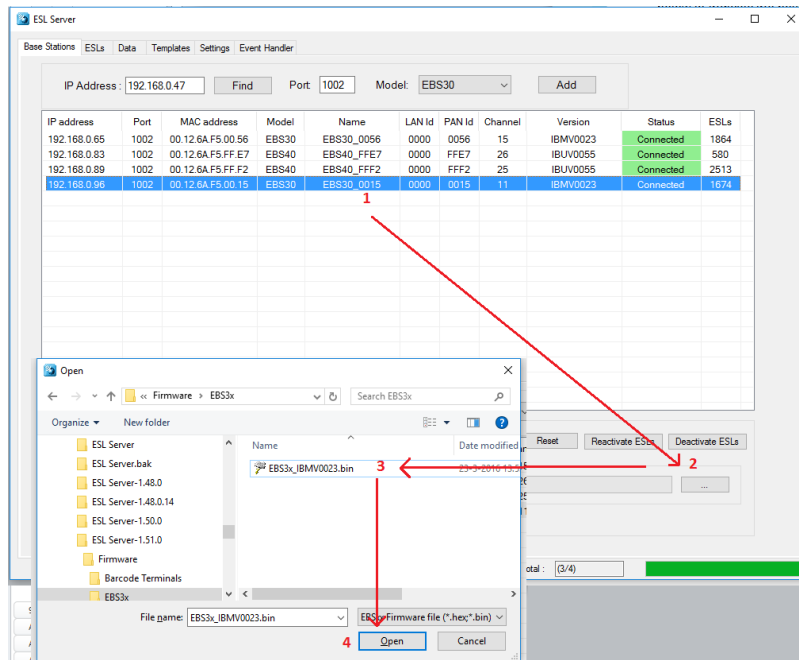
Updating the base station firmware

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5.6.1. Trouble shooting

If a firmware update fails, this can have a number of causes:

- Older firmware versions require the EBSxx and ESL server to be on the same subnet (connect the EBSxx on the same subnet)
- One of the following ports is use: 67, 68, 69, 1002 or 13633 by another process (use netstat to find out which process uses one of these ports.
- Your firewall of router is blocking on of the above ports.
- Your router/switch has its own bootstrap server (BOOTP) enabled. Check your manual of your router on how to disable BOOTP (i.e. using 'ip dhcp bootp ignore' on Cisco Systems) or connect the EBSxx directly to your ESL server,

6. Configuration and monitoring of ESLs

6.1. Configuration of ESLs

There are several configurations that can be made in the ESLs to control, customize them and to regulate power consumption.

To edit configurations of an ESL, go to the 'ESL'-tab base station tab and select the ESLs that you which to configure. To select multiple ESLs, use the shift- or ctrl-key.

After doing so, the current settings of the first selected ESL will be shown below.

Note: If the base station has not yet received the settings from this ESL, then you'll have to wait till the settings have been received from the ESLs. These are automatically requested the next time the ESL polls for data.

There are 6 configurations that can be edited. These configurations will be described in the following chapters:

- Associate Interval
- Poll interval
- Poll timeout
- Display orientation
- Poll - Info ratio

- Scan channels
- Temperature range

6.1.1. Associate interval

When an ESL is not connected to any base station it will automatically start looking for nearby base stations. Since searching for base station consumes a relatively large amount of power it will not continuously search, but only once every couple of seconds. The associate interval determines the time (in seconds) between two associating attempts of an ESL. The default associate interval is currently 60 seconds.

If ESLs stays disconnected for a longer period, then the associate interval will start to increase up to 15 minutes to minimize battery consumption.

The amount of power that is being consumed by the ESL, when it's not connected to any basestation, is also strongly related to the number of RF channels it is configured to search for base stations. More information about the configuration of the 'Scan Channels' can be found in chapter 6.1.6.

6.1.2. Poll Interval

The poll interval specifies the interval (in seconds) at which the ESL sends a poll for data to the base station. This parameter is the most significant configuration of an ESL since it strongly determines the response time of an ESL (how fast is an image displayed) as well as the battery lifetime.

By default, the ESLs poll every 20 seconds once they're connected to a base station. This means that to response time of an ESL can be anywhere in between 0 to 20 seconds (unless the poll doesn't arrive at the base station due to interference).

The poll interval greatly influences the battery lifetime, so lowering it is not recommended. For example, changing the poll interval from 20 seconds to 5 seconds will roughly triple the power consumption and thereby shorten the battery lifetime by a factor of 3.

An advantage of making the poll interval bigger is the reduction of the used bandwidth per ESL, making it possible to connect more ESLs to a single base station.

6.1.3. Poll timeout

The poll timeout specifies the number of polls without acknowledge from the base station after which the ESL will time out its connection and start searching for another base station. The default poll time out is currently 10 polls, so by default the time out is 10x20 seconds = 200 seconds.

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6.1.4. Display orientation

It is allowed to mount ESLs up-side-down. To make sure that the images are displayed correctly, the display orientation can be changed to 'Flipped'.

6.1.5. Poll - Info Ratio

The poll info ratio determines how often ESLs will automatically send their status and settings to the base stations. By default, the ESLs will transmit this information once every 40 polls, so a ratio of 1:39.

The status and information of an ESL is also requested immediately by selecting an ESL in the ESL-tab. This will cause the base station to request the settings the next time this ESL polls for data.

The poll info ratio is set to a relatively high value, because settings and status usually don't vary a lot. Also sending settings and status information uses more bandwidth and consumes more power than regular polls for data.

6.1.6. Scan channels

Once an ESL has associated (connected) to a base station, it operates on a single RF channel. However, when it's not yet connected to a base station, the ESL will automatically scan a range of RF-channels for base stations. The range of RF channels that an ESL will scan for base station is configurable. All channels in the range of channel 11 to 26 can be scanned by adding the channel in the dash-separated list of channels.

By default, channels 11, 15, 20, 25, 26 are enabled. Channel 11 can't be disabled to make sure that when an ESL that is not associating to any base station and its RF channel range is unknown, it can always be retrieved by configuring a nearby base station to channel 11.

6.1.7. Temperature range

Configures the temperature range at which the ESL is installed. Because e-paper displays become slower at low temperatures, lowering the temperature range compensates for this to avoid the display not updating correctly.

Only use this feature when the display is not updating correctly under low temperatures, because lowering the temperature range increases power consumption, because it takes longer to update the display. Also be aware that low temperatures decrease the battery capacity and thereby also the battery lifetime.

6.2. Monitoring of ESLs

All available information of an ESL can be displayed in the ESL-tab. Each column can be enabled or disabled by right-clicking of the column-header and (un)selecting items of the list below.

- Unique ID   Unique ID of the product to which the ESL is linked.
  - Red   Product was not found in product database / image file could not be found
- MAC   8-digit MAC address of the ESL
- Group   Product group as configured in the 'Data'-tab.
- Description   Product description as configured in the 'Data'-tab.
  - *<no color>*   *ESL is not linked to any product*
  - *Light green*   *Image on ESL is up to date*
  - *Dark green*   *Image is currently updating*
  - *Yellow*   *Image is currently updating (previous attempt failed)*
  - *Orange*   *Image is ready for updating, but the ESL has not polled*
  - *Red*   *Error: Image file could not be found / Image update failed*
  - *Light grey*   *ESL is missing / not associated to any base station*
- Poll Interval   Poll interval (see chapter 6.1.2)
- Poll Timeout   Poll time out (see chapter 6.1.3)
- Associate Interval   Associate interval (see chapter 6.1.1)
- Battery voltage   Current battery voltage (deprecated)
- Model   Hardware model of the ESL (i.e. EE200 / EE201)
- Version   Software version of the ESL firmware
- SubVersion   Software version of the sub-processor of the ESL (if present)
- Image Id   Image Id of the image on the ESL. (0=default image; >0=normal image)
- Backlight   Backlight setting of the ESL (only for TFT based ESLs)
- Display Orientation   Display Orientation (Normal or Flipped; See chapter 6.1.4)
- LQI   Indicator of the signal strength from an ESL (measured by base station)
  - Dark orange   (1-3) Link quality is poor and high packet loss (>60%)
  - Orange   (4-7) Link quality is poor and significant packet loss (>20%)
  - Yellow   (8-10) Link quality is poor, but no significant packet loss (<20%)
  - Light green   (>10) Link quality is good and no significant packet loss
- LQI (Rx)   Indicator of the signal strength from an ESL (measured by ESL)
- Last Poll   Time of the latest poll that has been received from the ESL
- Base Station   IP-address of the base station to which the ESL is currently connected
  - Light green   Base station is connected
  - Orange   Base station is not connected
  - Light grey   ESL is missing / not associated to any base station
- Status   Current state of the ESL.
- Temperature range   Temperature setting: 0=default (higher the value, the lower the temp.)
- Image status   Shows the current status of the image update
- Firmware status   Shows the current status of the firmware update

- LAN ID   Shows the preferred LAN-ID on which the ESL will look for base stations (0000=associate to any base station, XXXX = only associate to base stations with same LAN-ID or with 0000 only)
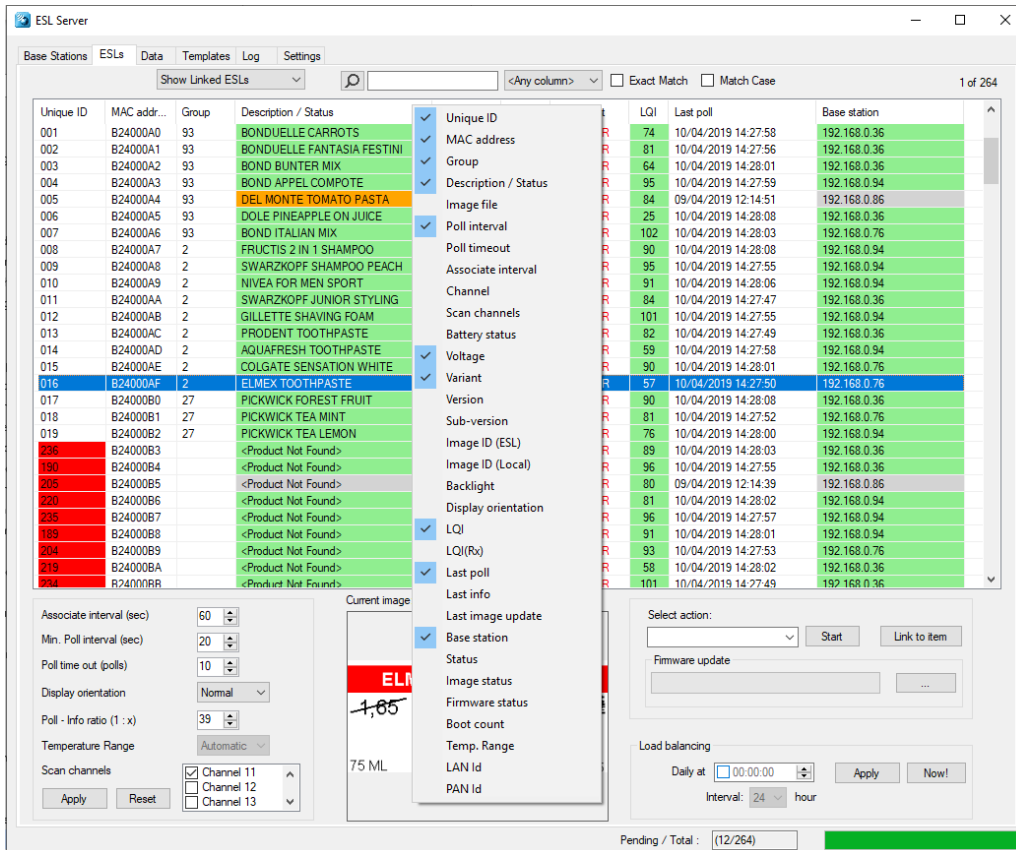
6.3.   Filtering ESLs

Using the filter options in the ESL-tab it's possible to sort and filter on almost any ESL property.

6.4.   Controlling ESLs

ESLs can be further controlled by using the 'Actions' of the ESL-tab. To use these features, select one of more ESLs and then select the action that you wish to execute.

Features that are unavailable for this ESL will be grayed out. Below a description of the different actions is given.

6.4.1. Actions
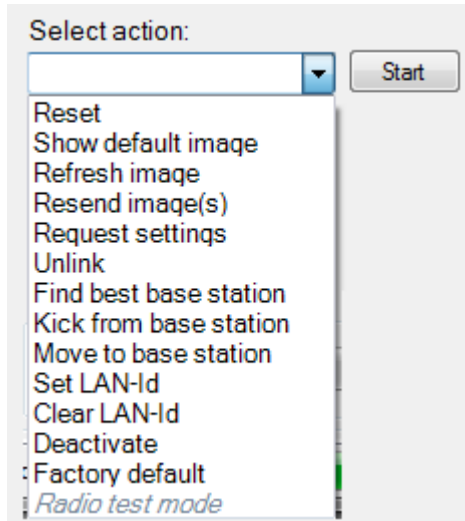
- Reset   Resets the firmware of the ESL, causing it to reassociate with the same base station
- Show default image   Make the ESL show the default image with its MAC address (if the ESL is linked, the default image is shown for 15 minutes after which the product image is send again)
- Refresh image   Refreshes the current image on the ESL
- Resend image   Resends the current image to the ESL
- Request settings   Force the ESL to send its current settings
- Unlink   Unlinks the ESL from the link database
- Find best base station   Search for a base station with a better link quality
- Kick from base station   Search for another base station
- Move to base station Move ESL to the specified base station
- Set LAN-Id   Sets the LAN-Id (see chapter 5.3)
- Clear LAN-Id   Clears the LAN-Id (see chapter 5.3)
- Deactivate   De-activate the ESL for transport or storage
- Factory default   Resets the firmware of the ESL to default
- Radio test mode   Used for certification only (disabled by default)

6.4.2. Load balancing / roaming

6.4.2.1 Load balancing

Load balancing offers the possibility to automatically and manually re-balance the ESLs over all available base stations. Enabling this option to run daily improves the average link quality of the ESLs, because all ESLs with poor link quality will check if there's a better base station available.

Especially after a new base station was added or after a base station was temporarily offline, it can be beneficial to execute load balancing manually.

Please note that load balancing significantly improves if ESL's run firmware IBxV0058 or higher.

Be aware that during the rebalancing of the ESLs, they can appear to be offline for 1 to 15 minutes, so it's safest to execute the daily load balancing at night to avoid slowing down the image updating process at daytime.

6.4.2.2   Roaming

With roaming enabled ESLs with a poor or unreliable connection regularly look for a better base station to connect with. This is particularly useful if ESLs are non-stationary and move around on carts or containers.

Please note that roaming requires ESL firmware IxxxV0164 or higher!

To enable roaming first to change the LAN-ID of all base station to a non-zero value in the base station-tab. All base stations need to be configured to the same LAN-D

Example of 2 base stations with a non-zero LAN-ID configured

Secondly, roaming needs to be 'enabled' by checking the 'Roaming'-checkbox in the ESLs-tab.

Finally, the LAN-ID on all ESLs in the network needs to be set. This can be done using two methods:

1) Deactivated ESLs (with *firmware IxxxV0159 or higher*):
   - ESLs will automatically set their LAN-ID during reactivation if the base station has a LAN-ID configured.

2) Activated ESLs that aren't configured on a specific LAN-ID need their LAN-ID to be set manually.

To do so, select all active ESLs (Ctrl-A) and use the 'Set LAN-ID' action to configure the LAN-ID.

The ESLs will now disassociate and start searching for the best base station with this LAN-ID. This can take a few minutes.

6.4.2.3   *Effect on power consumption with roaming enabled*

Enabling roaming can have both a positive and negative effect on the battery life of an ESL. This depends on the following factors:

- Connection quality:
    - If an ESL is connected to an EBS with a good connection, then the effect on battery life is virtually non-existent.
    - If connection quality is poor, this has a negative effect on the battery life because more retransmissions are needed to poll for data. Since roaming generally improves the average connection quality this can have a positive effect on battery life.

- If ESLs move around and/or have a poor connection, then the ESLs will look for a better connections every 10 polls (which is determined by the 'poll timeout'-setting).

    To do this, ESLs use a whitelist of all available base stations (with the same LAN-ID) and send a poll to all base stations in this list. This is done using an interval of 60 seconds (which is determined by the 'associate interval'-setting) divided by the number of base stations with the same LAN-ID.
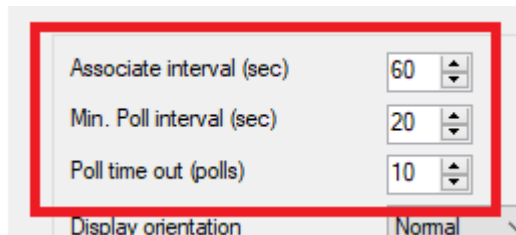
Settings that largely determine the battery life

With above default settings, this means that with 3 whitelisted base stations. The number of polls send by the ESLs is the same (60/3=20 sec interval) compared to having roaming disabled. So, battery life won't be effected negatively (or even improve due to better average connection quality).

If the number of base stations increases, then it's recommended to change the associate interval to a value equivalent to

Associate interval = <Number of base stations> x <poll interval (of 20 sec)>

This will make sure the battery life is not affected by enabling roaming. Otherwise, battery life can be reduced by ~5% for each additional base station.

6.4.3. Firmware update

To upgrade the firmware of ESLs, select one of more ESLs and then press the 'Firmware update' browse button and select the correct firmware file for these ESLs, which can be found in the 'Firmware' sub-folder of the installation. Make sure the first 3 characters of the firmware file match the reported first 3 characters of the reported firmware version by these ESLs.

Firmware update
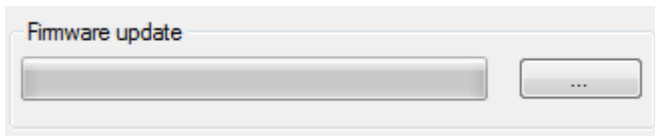
7. Database configuration

The ESL server support 8 different database formats:

CSV

Comma separated files. It's easy to set up and it's suitable for smaller projects and demos with a limited number of ESLs. The disadvantage is that the ESL server is difficult to control and monitor by an external server due to the limited feedback on the status of the ESL system. Also, CSV-based systems tend to become slow when used with large numbers (thousands) of ESLs. Status information is stored in an SQLite database file. See chapter 7.1.

MySQL

MySQL is an OpenSource relational database system. Requires knowledge about SQL databases and MySQL has to be installed on your system. MySQL provides the possibility to monitor and control multiple stores using one central of multiple local SQL databases in combination with the provided web application. MySQL is suitable for a large number of ESLs per ESL server. See chapter 7.2.

MS-SQL

MS-SQL is a relational database system from Microsoft. Same advantages and disadvantages as MySQL and Oracle. MS-SQL has a slightly better performance than MySQL, because the ESL server is developed on and runs on a Microsoft platform. To use the provided web-application it is recommended to create an ODBC data source. See chapter 7.2 and chapter 7.3.

Oracle

Oracle is a relational database system from Oracle. Same advantages and disadvantages as MySQL and MS-SQL. Oracle databases have tons of features, but this also makes them more complex to set up and requires serious knowledge about this database format.

To use the provided web-application it is recommended to create an ODBC data source. See chapter 7.2 and chapter 7.3.

PostgreSQL

PostgreSQL is an OpenSource relational database system. Requires knowledge about SQL databases and PostgreSQL must be installed on your system. To use the provided web-application it is recommended to create an ODBC data source. See chapter 7.2 and chapter 7.3.

SQLite

SQLite is a lightweight cross-platform relational database library. It requires some knowledge about SQL-databases. No additional software must be installed on your system and configurations are minimal. When using SQLite, it is recommended to apply changes to the product and link table by placing CSV-files into the Input-folder to avoid locked database conflicts. To use the provided web-application it is recommended to create an ODBC data source. See chapter 7.2 and chapter 7.3.

FireBird 3.0

FireBird SQL is an OpenSource relational database system. Requires knowledge about SQL databases and FireBird3.0 must be installed on your system. To use the provided web-application it is recommended to create an ODBC data source. See chapter 7.2 and chapter 7.3.

DB2

DB2 is a relational database system of IBM. Requires knowledge about SQL databases and a DB2 database must be installed on your system. Currently DB2 is only supported using an ODBC connection. To use the provided web-application it is recommended to create an ODBC data source. See chapter 7.2 and chapter 7.3.

ODBC

ODBC support makes it possible to connect to any SQL-based data source. ODBC makes it easier to connect to SQL based databases since it only requires a Data source name (DSN), username and password. Requires knowledge about ODBC and SQL-databases and it requires the installation of an ODBC-driver. An ODBC data source first needs to be configured using the **ODBC data source control panel**. Be aware that using an ODBC connection is generally slower than a direct connection to the SQL database. See chapter 7.3.

CSV & SQL hybrid

It is possible to combine the advantages of CSV and SQL by configuring a hybrid configuration with both CSV (to provide the product databases and ESL-product links) and SQL (to log all ESL and Base station status information). This makes it easy to link the back-office to the ESL server using CSV-files and all status information will be available for remote monitoring. See chapter 7.4

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7.1.   CSV Data base configuration

When using CSV-files, the ESL server application is triggered by files that are being placed in a specified 'Input' folder by the back office. These can be either: CSV-, image or template files. Using a shared folder, it's possible to allow external access by the back office from anywhere in the world.

If the back-office system is not yet available, then it's also possible to edit prices, links and products manually in the ESL server application in the 'Data'-tab.

Alternatively, there's also the possibility to manually place (and rename) some CSV-files in the 'Input folder' (see chapter 7.1.1) for demonstration purposes and testing.

To select the CSV-database format, select 'CSV' in the 'Data'-tab.
See chapter 9 for information about on setting up the back-office system.

7.1.1.   Changing the database format and settings

Important: Whenever you change the database format (i.e. by changing the field sequence or by adding/removing fields) or change the database set-up, then it will be necessary to place a new full copy of the product database in the 'Input'-folder. This will automatically trigger the parsing of database with the new format or settings.

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Input Folder

Directory in which the back office uploads the new product data files (see chapter 9.1. The database files must have the file extension **.csv** in order to be detected by the ESL server application.

Besides database files, it's also possible to place ESL-product link files (see chapter 9.2), template files, images and template files in this folder for processing.

Output Folder

It will contain 2 CSV-files:

- dbase.csv (combined product database)
- linked.csv (ESL-products links)

When using a bar code terminal for linking, it can also contain the following file:
- scan.csv (truncated article database)

Any processed CSV-files from the Input folder will be moved to the sub-folder:
- /Processed

CSV parser (deprecated)

Unique Id field: Field number of the unique product ID in the CSV-record. Even though the product ID must be unique, it is allowed to have multiple records with the same ID in your database with different barcodes.

Barcode field: Field number of the product barcode in the CSV-record. If the barcode field is the same as the Unique Id field or when the barcode field isn't unique or present, use the Unique Id field number for both configurations!

Description field: Field number of the product description in a CSV-record.
(The description is shown by the barcode terminal when a link is created, so the user can verify the correct product was linked).

Group field: Field number of the product group in a CSV-record. If no group field is present in the CSV-record, set the field number to '0'.

From price field: Field number that holds the 'from price' from the article. If no 'from price' is present in the CSV-record set it to the 'sell price field'

Sell price field: Field number that holds the current 'sell price' from the article. If no 'sell price' is present in the CSV-record set it to the '0'

Discount % field: Field number which holds the automatically calculated discount percentage. If the 'from price' and 'sell price' fields are equal or set to '0', then the discount percentage isn't calculated.

Currency Symbol: Holds the currency symbol. Used by the image generator to add the currency in front of the price. (Must be specified in the image template using %C%, see chapter 8)

Decimal Symbol: Holds the decimal symbol for prices, which can be either a dot or comma. If the user accidentally types in a comma instead of a dot (or vice versa) in a price field, then the CSV-parser will automatically correct this.

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Display leading zero: Specifies the price formatting when the price is smaller than one standard currency (i.e. 0.75). The CSV-parser can automatically format prices in any of the following three formats: 0.75, -.75 or .75.

7.2.   SQL Data base configuration

The ESL server supports MS-SQL, MySQL, SQLite, PostgreSQL, Oracle, FireBird and DB2, which need to be installed besides the ESL server application to use it.

- MS-SQL Express Server 2012 (with tools) is available at Microsoft.com.
- MySQL can be installed separately or using XAMPP (see chapter 11)
- Oracle Express can be downloaded from ORACLE.com
- PostgreSQL can be downloaded from postgresql.org
- SQLite is file based and does not require any installation or configuration.
- DB2 Express-C can be downloaded from IBM.com
- FireBird can be downloaded from firebirdsql.org

The ESL server application will generate most SQL tables automatically, except for the product tables, which contain the product database.

The ESL Server installation contains example queries to quickly set up a demo for each database format. The example queries can be found in the following folder of your installation

- '/Examples/'

MySQL demo configuration can be found in 'Appendix B: MySQL demo configuration'

MS-SQL demo configuration can be found in 'Appendix C: MS-SQL demo configuration'

Oracle demo configuration can be found in 'Appendix D: Oracle demo configuration'

PgSQL demo configuration can be found in 'Appendix E: PostgreSQL demo configuration'

SQLite demo configuration can be found in 'Appendix F: SQLite demo configuration'

DB2 demo configuration can be found in 'Appendix G: DB2 demo configuration'

FireBird demo configuration can be found in 'Appendix H: Firebird demo configuration'

Note: make sure the SQL-account, that is to be used by the ESL server, has enough rights to read, write and create these tables. Also makes sure that the used login doesn't require periodic password changes.

7.2.1.   Tables

When using SQL, the ESL server uses 10 SQL-tables to work properly, which have a couple of restrictions.

- A **product table** containing product information, which allows the image content on the ESLs to be automatically generated.

- A **product staging table**. Used to serve as the interface to add, modify and removes products from the product table

- **Link table** This table is automatically generated and is used to containing the links between products and links

- **Link staging table**. This table is automatically generated and is used as the interface to create and remove links from the link table

- **labelstatus table.** This table is automatically generated and is used to store all information about each ESL in the server. This table is described in chapter 7.2.1.5.

- **basestationstatus table**. This table is automatically generated and is used to store all information about each base station in the server. This table is described in chapter 7.2.1.6.

- **Logging table**. This table is automatically generated and is used to store events and alerts and exceptions to help trouble shooting in case of problems.

- **Users table.** This table holds the users, encrypted passwords and access rights

- **Change log table.** This table is used to log user activity.

The following chapters will describe these tables in more detail.

(The ESL server also creates 3 'action' tables, which are created to allow remote control over the ESL server using SQL queries. See Appendix J: Using the SQL API.

7.2.1.1   Link table

Important note: Only the ESL server can modify this table directly. A link staging table is used for changing the content of this table, which is described in the following chapter.

The ESL server requires a link table that contains the links between the products and ESLs.

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If no Link-Table is supplied, then one will be automatically created (called "links") in the following format:

CREATE TABLE links
(
  [ID] VARCHAR(40),
  [Variant] VARCHAR(8),
  [MAC] VARCHAR(16) NOT NULL PRIMARY KEY
)

If you wish to name the table or columns differently, this is allowed. You can do so by creating a table with the same format, but different table and column names.

The 1st column (ID) should contain the unique product code.
The 2nd column (Variant) should contain the ESL variant (i.e. EE201)
The 3rd column (MAC) should contain the MAC (or IEEE) addresses of the ESLs.

It can link the same product to multiple ESLs.

7.2.1.2 Link staging table

Staging tables are the interface tables between the remote database from the back office and the local SQL databases used by the ESL server.

If no Link staging-Table is supplied, then one will be automatically created (called "Links_Staging") in the following format:

CREATE TABLE links_staging
(
  [ID] VARCHAR(40),
  [Variant] VARCHAR(8),
  [MAC] VARCHAR(16) NOT NULL PRIMARY KEY,
  [DELETE] VARCHAR(1)
)

Changed links should be inserted in the link staging table and the ESL server will automatically detect and process this data and insert the data into the Link table. If the processed data requires an ESL to be updated, it will automatically generate a new image and sent it to the ESL.

The link staging table must have the same formatting as the link table but should also contain a 'DELETE' column. The 'DELETE' column makes it possible to remove a link from the link table, by placing an 'X' in this column*.

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* Oracle requires the column 'DEL' instead of 'DELETE'

7.2.1.3 Product table

The product table should at least contain all the product information, which should be shown on the automatically generated image of ESLs.

Example queries for each SQL database format and matching configurations can be found in:

- Appendix B: MySQL demo configuration

- Appendix C: MS-SQL demo configuration

- Appendix D: Oracle demo configuration

- Appendix E: PostgreSQL demo configuration

- Appendix F: SQLite demo configuration

- Appendix G: DB2 demo configuration

- Appendix H: Firebird demo configuration

The only mandatory column in the product table is the (product) ID column. If no additional barcode column is used, this column should be a VARCHAR string and marked as the PRIMARY KEY.

Always make sure to configure the 'Unique ID' field in the 'Data'-tab as well.

It is recommended to name the [ID] column of the link table the same as the [ID] column of the product table.

The names and formats can be changed as desired. An example of a product table is shown below.

```
CREATE TABLE products (
  [ID] VARCHAR(20) PRIMARY KEY,
  [Description] VARCHAR(60),
  [Group] VARCHAR(10),
  [Std. Price] VARCHAR(10),
  [Sell Price] VARCHAR(10),
  [Content] VARCHAR(20),
  [Unit] VARCHAR(10))
```

If barcodes, like EAN/UPC, are used for linking, then be aware that **multiple EAN/UPC barcodes can exist for the same product(!)** making them unsuitable as 'Unique ID'.

In this situation the barcode column would be the 'PRIMARY KEY', but the product ID-column must be configured as 'Unique ID'.

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An example of a product table with barcodes is shown below.

CREATE TABLE products
(
[Barcode] VARCHAR(20) PRIMARY KEY,
[ID] VARCHAR(20),
[Description] VARCHAR(60),
[Group] VARCHAR(10),
[Std. Price] VARCHAR(10),
[Sell Price] VARCHAR(10),
[Content] VARCHAR(20),
[Unit] VARCHAR(10))

The configuration in the 'Data'-tab would then become:

7.2.1.4   Product staging table

Changed product information should be inserted in the product staging table and the ESL server will automatically detect and process this data and insert the data into the Product table. If the processed data requires an ESL to be updated, it will automatically generate a new image and sent it to the ESL.

The product staging table must have the exact same formatting as the product table but should also contain a 'DELETE' column. The 'DELETE' column makes it possible to remove a product from the link table, by placing an 'X' in this column. *

The product staging table that matches the previous product table examples are shown below.

CREATE TABLE products_staging
(
[ID] VARCHAR(20) PRIMARY KEY,
[Description] VARCHAR(60),
[Group] VARCHAR(10),
[Std. Price] VARCHAR(10),
[Sell Price] VARCHAR(10),
[Content] VARCHAR(20),
[Unit] VARCHAR(10),

[DELETE] VARCHAR(1))

Or with barcode column:

CREATE TABLE products_staging
(
[Barcode] VARCHAR(20) PRIMARY KEY,
[ID] VARCHAR(20),
...)

* Oracle requires the column 'DEL' instead of 'DELETE'

7.2.1.5   ESL status and configuration table

When using SQL, the ESL server automatically creates a table called 'labelstatus'. This table is used to store all information about each ESL in the server and has the following table design.

Column Name	Data Type	Allow Nulls
ID	varchar(40)	☑
🔑 MAC	varchar(16)	☐
[GROUP]	varchar(50)	☑
DESCRIPTION	varchar(100)	☑
IMAGE_FILE	varchar(80)	☑
POLL_INTERVAL	int	☑
POLL_TIMEOUT	int	☑
SCAN_INTERVAL	int	☑
BATTERY_STATUS	int	☑
BATTERY_VOLTAGE	decimal(5, 2)	☑
VARIANT	varchar(5)	☑
FIRMWARE_VERSION	varchar(10)	☑
FIRMWARE_SUBVERSION	varchar(10)	☑
IMAGE_ID	int	☑
IMAGE_ID_LOCAL	int	☑
BACKLIGHT	int	☑
DISPLAY_OPTIONS	int	☑
LQI	int	☐
LQI_RX	int	☑
LAST_POLL	datetime	☑
LAST_INFO	datetime	☑
LAST_IMAGE	datetime	☑
BASE_STATION	varchar(25)	☑
SCAN_CHANNELS	int	☑
STATUS	int	☑
FIRMWARE_STATUS	int	☑
IMAGE_STATUS	int	☑
X	int	☑
Y	int	☑
WIDTH	int	☑
HEIGHT	int	☑
IMG_IX	int	☑
IMG_FORMAT	int	☑
BOOT_COUNT	int	☑
TEMPERATURE	int	☑
LANID	varchar(4)	☑

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Below an overview is given of the different fields in the 'labelstatus' table.

ID	Unique article ID to which the ESL is linked. <Null> or empty if the ESL is/was present in the ESL system, but not linked.
MAC	8-digit hexadecimal IEEE (MAC) address of the ESL.
GROUP	If a group field is configured in the Data-tab, this field will contain the group of the product linked to the ESL
DESCRIPTION	If ESL is linked, this field will contain the configured product description. <Null> if not linked or unknown
IMAGE_FILE	If ESL is linked, this field will contain the file name of the automatically generated image content. <Null> if not linked.
POLL_INTERVAL	If ESL is physically present, this field will contain the poll interval of the ESL. <Null> if the poll interval is unknown
POLL_TIMEOUT	If ESL is physically present, this field will contain the poll timeout of the ESL. <Null> if the poll timeout is unknown
SCAN_INTERVAL	If the ESL is physically present, this field will contain the scan/associate interval of the ESL. <Null> if the interval is unknown.
BATTERY_STATUS	If the ESL is physically present, this field will contain the battery status of the ESL. (Full=1; Almost full=2; half full=4; low=8, Empty=16, Unknown / N.A. = 32 or NULL)
VARIANT	When ESL is physically present or linked, this field will contain the variant of the ESL. 'i.e. EE201 <Null> = Unknown
FIRMWARE_VERSION	This field will contain the software version of the ESL. Typically in the format: IBxVyyyy. <Null> = Unknown
FIRMWARE_ SUBVERSION	This field will contain the software subversion of the ESL. Typically, not used by e-paper based ESLs. <Null> = Unknown
IMAGE_ID	This field will contain the image ID of the image shown on the ESL. 0=default image; 1=custom Image; <Null> = Unknown. In the future the ESLs can contain multiple images.
BACKLIGHT	If ESL is physically present, this field will contain the back light setting (ranging from 5-100(%), <Null> = unknown). Only used by TFT based ESLs
DISPLAY_OPTIONS	If the ESL is physically present, this field will contain the image orientation. 0=Normal, 1=Upside-down, <Null> = unknown
LQI	This field will contain the last received Link-Quality-Index, indicating the connection strength with the base station. -1 Unknown / not connected 0-3 Link quality is poor and high packet loss (>40%) 4-7 Link quality is poor and significant packet loss (>20%) 8-10 Link quality is poor, but no significant packet loss (<20%) >10 Link quality is good and no significant packet loss
LQI_RX	This field will contain the last received Link-Quality-Index measured by the ESL, indicating the connection strength with

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	the base station. Ranges from 1-255 is fine, 0 is poor, <Null>=unknown.
LAST_POLL	This field will contain the UTC time of the last received poll for data. <Null> means unknown / never received. (This field is currently not updated on each poll to reduce the amount of SQL queries executed by the ESL server).
LAST_INFO	This field will contain the UTC time of the last reported status by the ESL. <Null> means unknown / never received.
LAST_IMAGE	This field will contain the UTC time of the last successful image update. <Null> means unknown or hasn't been updated.
BASE_STATION	If the ESL is/was connected to a base station, this field will contain the IP address of the last base station it was connected to. String format is xxx.xxx.xxx.xxx (i.e. 192.168.0.12). <Null> = unknown or never connected. Use the 'STATUS' field to verify if the ESL is currently connected or not.
SCAN_CHANNELS	This field contains an integer value of which each bit represents an RF-channel on which the ESL will or will not search for base stations (when not connected). Example: 101746688 would represent a binary value of '110000100001000100000000000'. Counting from right to left this means, channels 11, 15, 20, 25 and 26 will be searched. <Null> = unknown.
STATUS	This field contains an integer value representing the last reported status of the ESL. <NULL> = Unknown 0 = ASSOCIATED 1 = POLLING 2 = INFO RECEIVED 3 = DISASSOCIATED 4 = COMMAND COMPLETED 5 = COMMAND NOT_ACCEPTED / DISGARDED 6 = POLL TIMEOUT 7 = COMMAND_TIMEOUT 8 = ADDRESS CHANGED (factory status only) 9 = DEACTIVATED 10 = IMAGE_UPDATE_COMPLETED 11 = IMAGE_UPDATE_FAILED 12 = FIRMWARE_UPDATE_COMPLETED 13 = FIRMWARE_UPDATE_STARTED 14 = FIRMWARE_UPDATE_FAILED 15 = REACTIVATED

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FIRMWARE_STATUS	This field contains an integer value representing the last reported status of the ESL. <NULL> = Unknown 0 = Idle 1 = Firmware update pending 2 = Firmware update queud 3 = <not used for firmware updates> 4 = Firmware update failed 5 = <not used for firmware updates> 6 = <not used for firmware updates> 7 = <not used for firmware updates> 8 = Firmware update succesfully completed
IMAGE_STATUS	This field contains an integer value representing the last reported image status of the ESL. <NULL> = Unknown 0 = Idle 1 = Image update pending 2 = Image update queued 3 = Image update queued; next already pending 4 = Image update failed 5 = Image update failed, waiting for retry 6 = Image update failed, busy retrying 7 = Image update failed, busy retrying, next pending 8 = Image updated succesfully 16 = Image error (image could not be opened, found or generated)
X, Y	If the ESL is linked, these fields contain an integer value of the X-, Y-offset of the generated image on the ESL. Generally, these values will be '0'. <Null> = Unknown or not linked
WIDTH, HEIGHT	If the ESL is linked, these fields contain an integer value of the width and height (in pixels) of the generated image on the ESL. Generally, these values will be 200 x 96 for the EE201. <Null> = Unknown or not linked
IMG_IX	This field will generally be '0'. Only if multiple products are shown on a single large ESL, then IMG_IX will be different for each image that is displayed on the ESL. <Null> = Unknown or not linked
IMG_FORMAT	If an e-paper ESL is linked, this field will generally be set to '1' indicating that the image is transmitted compressed to the ESL. If the data is sent uncompressed it would be '0'. Other values are reserved for TFT based ESLs (TIFF=2, JPG=3, GIF=4, FIRMARE=5).

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	\<Null> = Unknown or not linked
BOOT_COUNT	Shows how many time the firmware of the ESL was reset
TEMPERATURE	Shows the temperature range on which the ESL is supposed to run on (0=default; higher values are to compensate for low temperatures). Please note that low temperatures and values > 0 will increase power consumption!
LANID	LANID = 0000 means ESL will associate to all base stations. LANID <> 0000 means ESLs will only associate to base stations with the same LANID or with LANID 0000

7.2.1.6   Base station Status table

When using SQL, the ESL server automatically creates a table called 'basestationstatus'. This table is used to store all information about each base station in the server application and has the following table design

	Column Name	Data Type	Allow Nulls
🔑	MAC	varchar(17)	☐
	IP_ADDRESS	varchar(15)	☑
	PORT	int	☑
	MODEL	varchar(10)	☑
	NAME	varchar(25)	☑
	PAN_ID	varchar(4)	☑
	CHANNEL	int	☑
	VERSION	varchar(10)	☑
	STATUS	varchar(15)	☑
	ESLS	int	☑
	MIN_LOAD	int	☑
	MAX_LOAD	int	☑
	LAN_ID	varchar(4)	☑

MAC	12-digit hexadecimal MAC address of the base station
IP_ADDRESS	Current IP address of the base station
PORT	Current IP port number of the base station
MODEL	Current hardware model of the base station (EBS30/EBS31/EBS40)
NAME	Current local name f the base station
PAN_ID	Current PAN-Id on which this base station operates
CHANNEL	Current RF-channel on which this base station operates
VERSION	Firmware version of the base station
STATUS	Current connection status (Connected or Disconnected)
ESLS	Current number of associated ESLs to this base station
MIN_LOAD	RFU (for load balancing)
MAX_LOAD	RFU (for load balancing)
LAN_ID	LANID = 0000 (default) means all ESL will associate with this base station. LANID <> 0000 means only ESLs with the same LANID or with LANID=0 will associate with this base station

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7.2.1.7   Logging table

When using SQL, the ESL server automatically creates a table called 'esllog. This table is used to store all alerts and events, except user activity. This table has the following table design

	Column Name	Data Type	Allow Nulls
🔑	ID	int	☐
	BASESTATION	varchar(25)	☑
	ESL	varchar(16)	☑
	TIME	datetime	☑
	MESSAGE	varchar(256)	☑

7.2.1.8   Change log table

When using SQL, the ESL server automatically creates a table called 'changelog. This table is used to store user activity. This table has the following table design

	Column Name	Data Type	Allow Nulls
🔑	ID	int	☐
	[USER]	varchar(80)	☑
	TIME	datetime	☑
	MESSAGE	varchar(255)	☑
	[FROM]	varchar(255)	☑
	[TO]	varchar(255)	☑
	BASESTATION	varchar(25)	☑
	ESL	varchar(16)	☑

This table is used by the ESL server and the Web application.

7.2.1.9   User table

When using SQL, the ESL server automatically creates a table called 'user. This table is used to store usernames, encrypted password and access rights.

	Column Name	Data Type	Allow Nulls
🔑	[USER]	varchar(64)	☐
	PASSWORD	varchar(64)	☑
	RIGHTS	varchar(16)	☑

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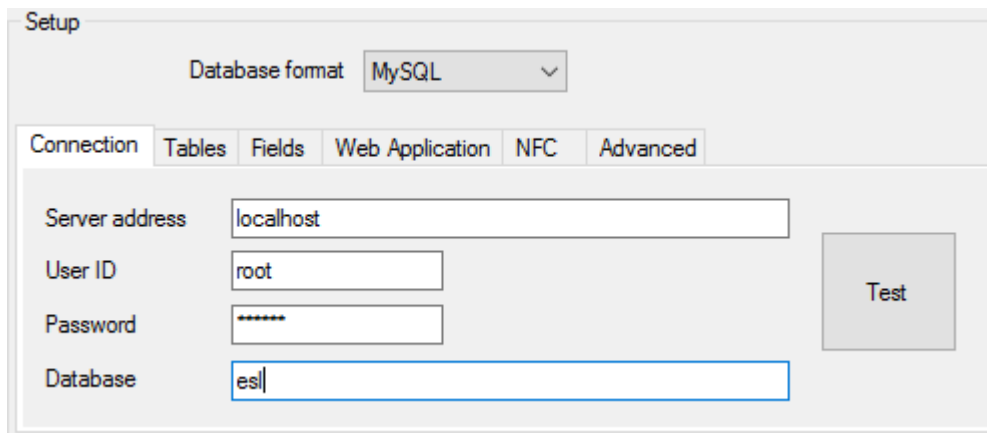
This table is used for user access control by the ESL server and the Web application. Users can only be added, removed or altered in the ESL server application.

7.2.2. Connection

To configure the connection with the SQL database, first select which type of SQL database is used. This can be MySQL, MS-SQL, SQLite, FireBird, Oracle and PostgreSQL.

Alternatively, an ODBC data source can be used to connect to a SQL based database. See chapter 7.3 for more information.

Next, fill in the SQL Server address, login, password and database name and press 'Test' to verify the connection with the SQL server is configured correctly.

7.2.3. Tables configuration

After a successful connection to the SQL server select the two product tables and two link tables.

The other tables will be generated automatically but can be renamed if desired.

7.2.4. Fields configuration

The Fields-tab configures which fields of the product table are the 'Barcode', 'Unique ID', 'Group' and 'Description' field. (The sell and standard price are used only by the web application)

7.2.5. Web Application

Configuration of the Web application is described in Chapter 11.

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7.2.6. Advanced Settings

7.2.6.1 Currency

The selected currency is used only by the Template editor in case a 'Currency' field is added in a template.

7.2.6.2 Culture info

The culture info setting must match the culture settings of the SQL database to avoid issues with notation differences of decimal separators (dot or comma).

7.2.6.3 Process staging tables interval

The 'process staging tables' setting specifies how often staging tables are processed (in seconds)

7.2.6.4 Update status tables interval

The 'update status tables' setting specifies how often the ESL server updates the status of the ESLs and base stations in the database.

7.2.6.5 Generate column for layering support

Only use this option when multiple products must be displayed on a single ESL!

Adds an extra column to the link-tables to support multiple products on a single ESL

7.2.6.6 Load only linked products in memory

Enable this option when the product table is extremely large (i.e. more than 1 million items) or when the product table is 'read only' for the ESL server.

Create and select an extra product table in which the ESL server can store the product information of all the products that are linked to an ESL. The structure of this table must be identical to the structure of the selected 'Product Table'.

Note: Finding products that are not linked to an ESL and altering products in the Data-tab is not possible when this option is enabled.

7.2.6.7   Field separator (for CSV-import)

When using SQL it is still allowed to input CSV-files (product and link files) into the configured Input-folder as long as the format of the number of columns and the sequence of the columns in the CSV-file matches the product and/or link table.

The field separator option configures the field separator that is used in the CSV-files.

7.2.7.   Apply and reset

Press 'Apply' to finish the configuration.

After a successful configuration, it is now possible to start adding products to the product staging table using standard SQL queries.

An example of a query to add a product to the product staging table would look like this:

CREATE TABLE products_staging
(
[ID] VARCHAR(20) PRIMARY KEY,
[Description] VARCHAR(60),
[Group] VARCHAR(10),
[Std. Price] VARCHAR(10),
[Sell Price] VARCHAR(10),
[Content] VARCHAR(20),
[Unit] VARCHAR(10),
[DELETE] VARCHAR(1)
)

INSERT INTO [products_staging] (
[ID],
[Description],
[Group],
[Std. Price],

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```
[Sell Price],
[Content],
[Unit],
[DELETE])
VALUES
('031',
'HOUSE WINE RED',
'30',
'3,00',
'3,00',
'2',
'LT',
''
)
```

To delete a product use 'X' as value for the [DELETE] field. *

An example of a query to add a new link to the link staging table would look like this:

```
INSERT INTO links_staging ([ID], [Variant], [MAC], [DELETE])
VALUES ('008', 'EE213R', 'B26001D4', '');
```

To delete a link, use 'X' as value for the [DELETE] field and [ID] and [Variant] can be left empty.

```
INSERT INTO links_staging ([ID], [Variant], [MAC], [DELETE])
VALUES (NULL, NULL, 'B26001D4', 'X');
```

* Oracle requires the column 'DEL' instead of 'DELETE'

Links can also be added manually, which is described in the following chapters.

It's also possible to create links by using the supplied web application for Wi-Fi barcode terminals like the H22, which allows quick linking by scanning the barcode on a product and the barcode on the ESL. This requires a web server running the web-app and a barcode field to be present in the product table or otherwise a separate product look-up table to be present. See chapter 11 for more information.

7.3.   Open Database Connectivity (ODBC) configuration

ODBC support makes it possible to connect to the following SQL-based data sources:

- MS-SQL
- SQLite
- PostgreSQL
- MySQL
- Oracle
- FireBird
- DB2

Connecting to an ODBC data source only requires a Data source name (DSN), username and password, which makes the configuration in the ESL server easier.

Before configuring the ESL server, first make sure the ODBC data source has been created using the **ODBC data source control panel** as **System DSN** and that the required ODBC driver has been installed. Make sure that the 32-bit or 64-bit architecture of the ODBC connection matches that of the ESL server (and, if used, of the HTTP-server of the web application).

Below you'll find a few example configurations for various ODBC data sources.
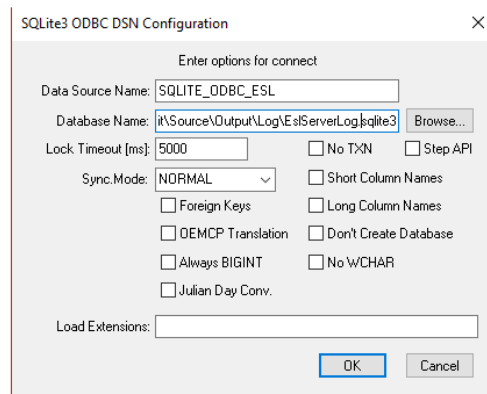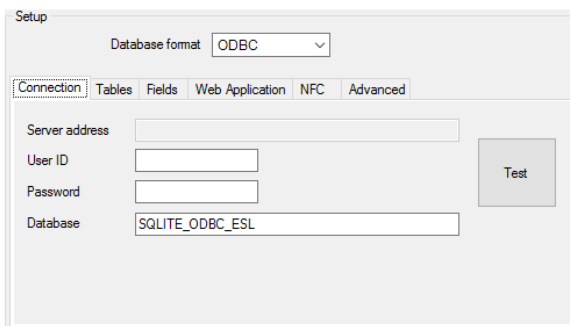
ODBC DSN configuration to a SQLite database

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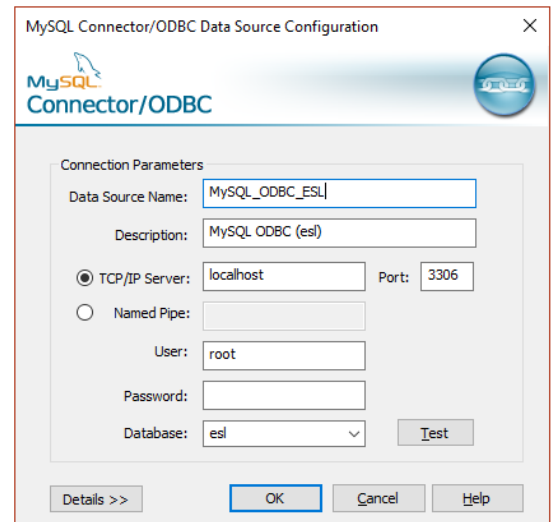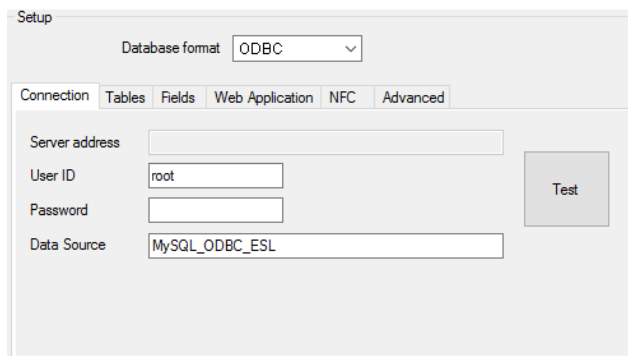
ODBC DSN configuration to a MySQL database

ODBC DSN configuration to an Oracle database

ODBC DSN configuration to a PostgreSQL database
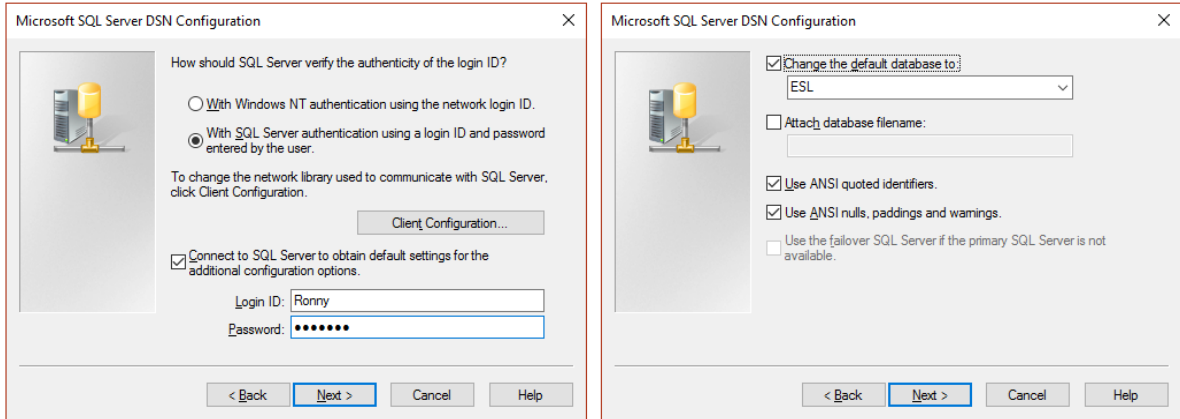
ODBC DSN configuration to a MS-SQL express database
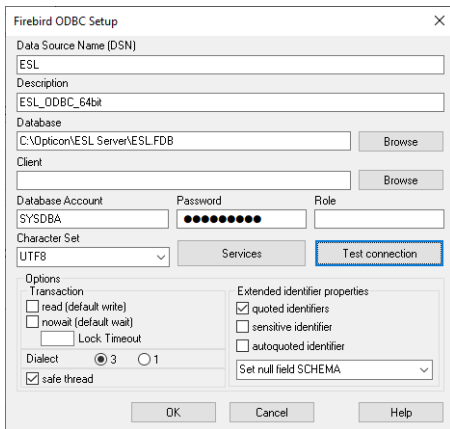
ODBC DSN configuration to a FireBird database
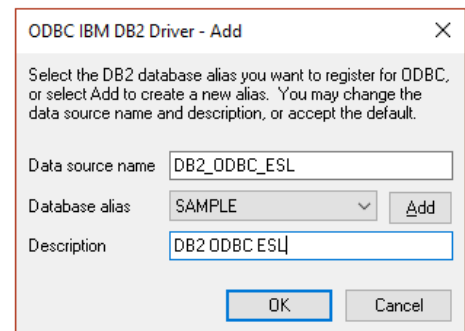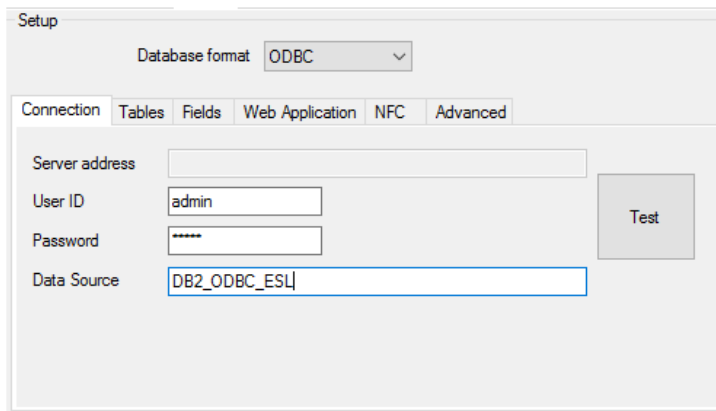
ODBC DSN configuration to a DB2 database

7.4. CSV / SQL Hybrid configuration

When using a CSV / SQL hybrid solution the product databases and ESL-product links are provided by CSV-files, but all ESL and Base station status information are logged into an SQL database. This makes it easier to link the back-office to the ESL server using simple CSV-files and all status information is logged into an SQL database for external monitoring and trouble shooting. Also, the start-up time of the ESL server will be significantly faster when many ESLs are linked compared to using CSV only.

To make such a configuration, start by configuring the ESL server with a standard CSV configuration as described in chapter 7.1.

When done, go to the 'Settings'-tab and change the 'database format' for logging to the desired SQL database format as shown below.
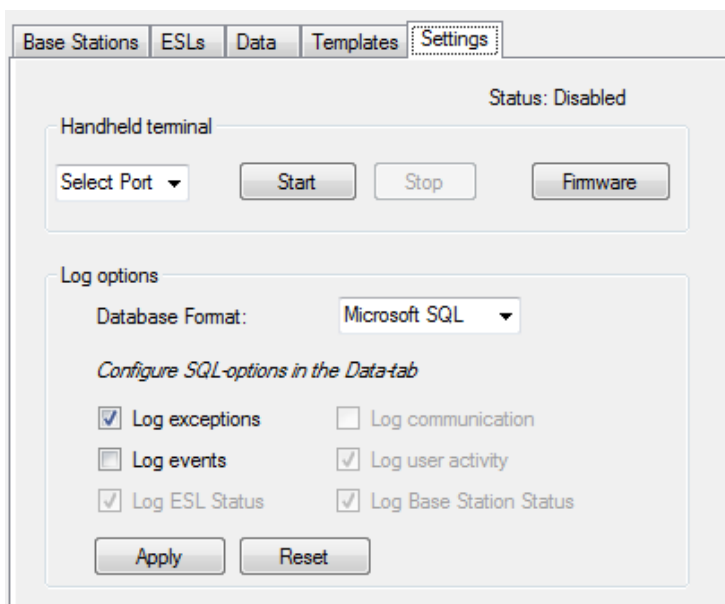
After that, go back to the 'Data'-tab and temporarily change the 'Database format' to the desired SQL format as shown below.

Configure all SQL options as described in the previous chapter but clear the product and link table fields.

When done, the SQL table configuration should look like this:

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To test the SQL configuration, press the 'Test' button. If the connection is OK, then press 'Apply' to save the SQL configuration.

The various SQL tables will be automatically created.

After that, change back the 'Database format' to 'CSV' and press 'Apply' again to finish the configuration.

7.5.   External content management configuration

When using the external content management solution, the 3rd party content management system handles the generation of the images and the linking of products to ESLs.

The ESL server application monitors an input folder for new images and distributes them to the corresponding base stations / ESLs.

The only main database configurations for this set-up in the ESL server are the 'Input' and 'Output' folder (select CSV-database format). The other configurations will be ignored.

If the 'Output' folder already contains the files 'dbase.csv' or 'linked.csv' then these files should be removed, so the system won't use them as product or link database

Optionally, status information can be logged into a SQL database using the same configuration as described in chapter 7.4

If desired, remote control over the base stations and ESLs can be achieved using SQL queries as described in 'Appendix J: Using the SQL API'

When the images for ESLs are generated and supplied by the content management system, then they must meet the following criteria:

- The image format must be either .bmp, .gif or .png

- The images must be monochrome or black/white/red (so no gray scale or anti-aliasing allowed!).

- Each image file must be uniquely named for each ESL (it's not allowed to use the same image file for multiple ESLs)

To process image files automatically the ESL server they should be placed in the configured 'Input'-folder, accompanied by a matching xml-info file.

The xml-info file provides the ESL server application with information on which image should be shown on which ESL and some other optional information which is displayed in the ESL server application.

The file name of the xml-info file is predetermined to:

```
<MAC address>.XML (i.e. B2600123.xml)
```

Example of an xml-info file:

```
<?xml version="1.0" encoding="utf-8"?>
<EslImageInfo xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
<ImageFile>B2600123.png</ImageFile>
<ID>018</ID>
<Group></Group>
<Note>Pickwick Tea Mint</Note>
</EslImageInfo>
```

The variable fields are described below:

<ID>	:	Unique product identifier
<ImageFile>	:	Must match the image file name for this ESL (.bmp, .gif or .png)
<Group>	:	Group field is intended to supply additional information to the user on the product group in the 'ESL'-tab (useful for sorting or searching)
<Note>	:	Note field is intended to supply additional information to the user about the product in the 'ESL'-tab (useful for sorting or searching)

To unlink an ESL, place an XML-file into the 'Input'-folder with following name format:

<MAC address>.XML

To indicate this ESL should be **unlinked** leave the ImageFile-field empty:

<ImageFile></ImageFile>

7.6. Manual editing of the product database

Using the 'Data'-tab of the ESL server application it is possible to quickly view and edit the content of the current product database. To do this, select the field that you wish to change and edit the value.

After editing, press the 'Save Changes' button in the lower-left corner to apply the changes. The changes will be automatically processed and sent to the ESLs if the resulting image is altered. To undo any unsaved changes, press the 'Reload' button to reload to the original database.

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7.7. Editing the Links-table

The 'Links' table tells the system which product should be shown on which ESL by linking the MAC address of the ESL to a unique product ID.

The unique ID can be anything: an EAN code, article number, location, room number, etc. As long as it's a unique identifier, it can be linked to an ESL.

Chapter 4 provides more information on how to link products to ESLs.

8. Designing the ESL image layout

Probably the most important step in the customization process of the ESL system is specifying the images that should be displayed on the ESLs.

The template editing consists of 2 parts:

- **Template selection**   Determines which template should be shown on which ESL variant (i.e. EE201 or EE440) and under which conditions (i.e. discount or no discount)

- **Template editing**   Determines the layout of the image that will be shown on the ESL

Both aspects will be described in the following chapters.

When designing the layout of an e-paper ESL, it's important to know the limitations of what can and what can't be displayed on an ESL.

The main characteristics are:

- Fixed resolution (i.e. 200x96 pixels for the EE20x)
- Monochrome images (for black & white ESLs) or Black/white/red images (for BWR ESLs)
- No anti-aliasing can be used on fonts (limiting the number of available fonts)
- Black / white (/red) company logos or other images can be added to the layout.
- 1D- and 2D-Barcodes can be added using information from the database
- Texts, images and barcodes can be rotated in steps of 90°
- Dynamic texts, using information from the database, can be added and aligned as desired.

The 'Templates'-tab contains the following configurations:

- **Template Folder**   Folder in which all templates are stored. The default location of the templates is "/Templates".

- **Images Folder**   All automatically generated images will be placed in this folder. Once these images have been sent to ESLs they will be moved to the sub-folder: '/Completed'

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8.1.   Template Selection

Template selection determines which image template is used under which conditions.

The template selection area lists all the found templates in the specified 'Template folder' and shows if the template is currently enabled and, if so, under which condition it must be used.
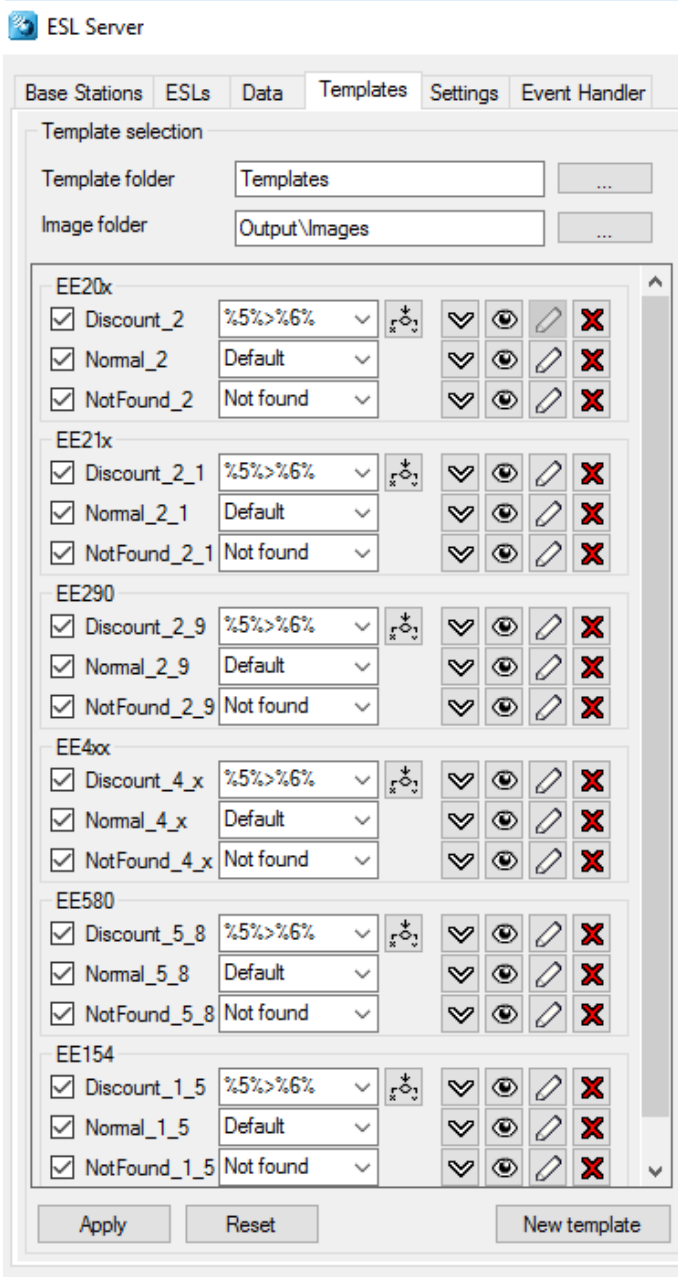
Example of the template selection area

8.1.1. Conditions

To make it possible to use different templates under different conditions, a template can be configured as:

- 'Default'- template   Used if an ESL is linked to a **known** product
- 'Not found'-template   Used if an ESL is linked to an **unknown** product
- Conditional-template   Used when the specified condition is TRUE
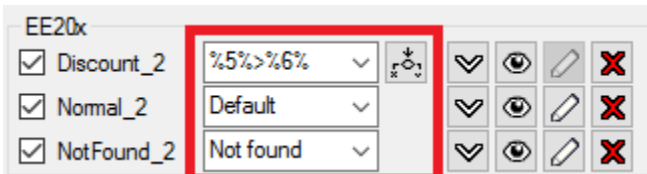
Conditional templates can be configured by selecting '<Conditional>' in the dropdown-list or edited by pressing the 'Condition editor' icon.
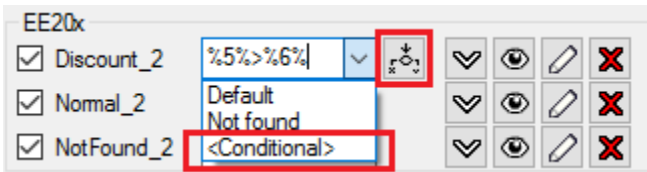
The condition editor allows you to specify up to 4 conditions under which the template should be used.
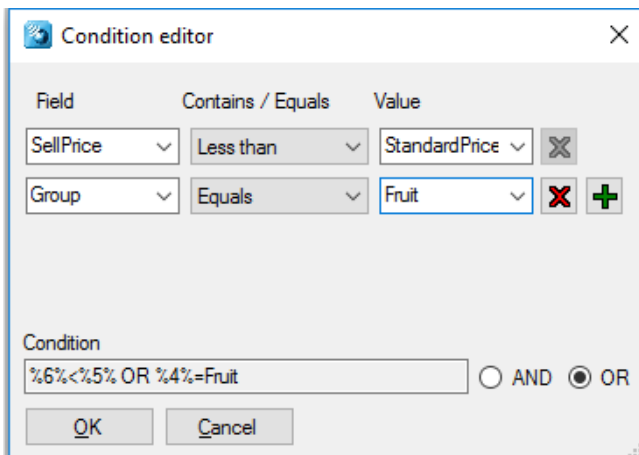
Press OK to apply the condition for this template.

Hints and tips:

- Only 1 'Default'-template can be enabled at a time

- Only 1 'Not found'-template can be enabled at a time

- 'Conditional'-templates will be listed first, because the first template with a matching condition will be used.

- Use the ⌄ - button to change the template sequence.

- Use the 👁 -button to preview a template

- Use the ✏ -button to edit a template

- Use the ✖ -button to **permanently** delete a template

When done editing the template selection, press the 'Apply' button to save the template selection and apply the templates to any linked ESLs.

Use 'Reset' to revert all changes in the template selection (deleted templates can't be reverted!)

Apply	Reset

To create a new template, press the New template button, after which the 'Create New Template'-dialog will appear to create a new template for a specific type of ESL.

Create New Template ✕

File name: Default_2

Variant: EE20x ⌄

OK   Cancel

After pressing the 'OK'-button a new template is created, which you can start editing immediate.
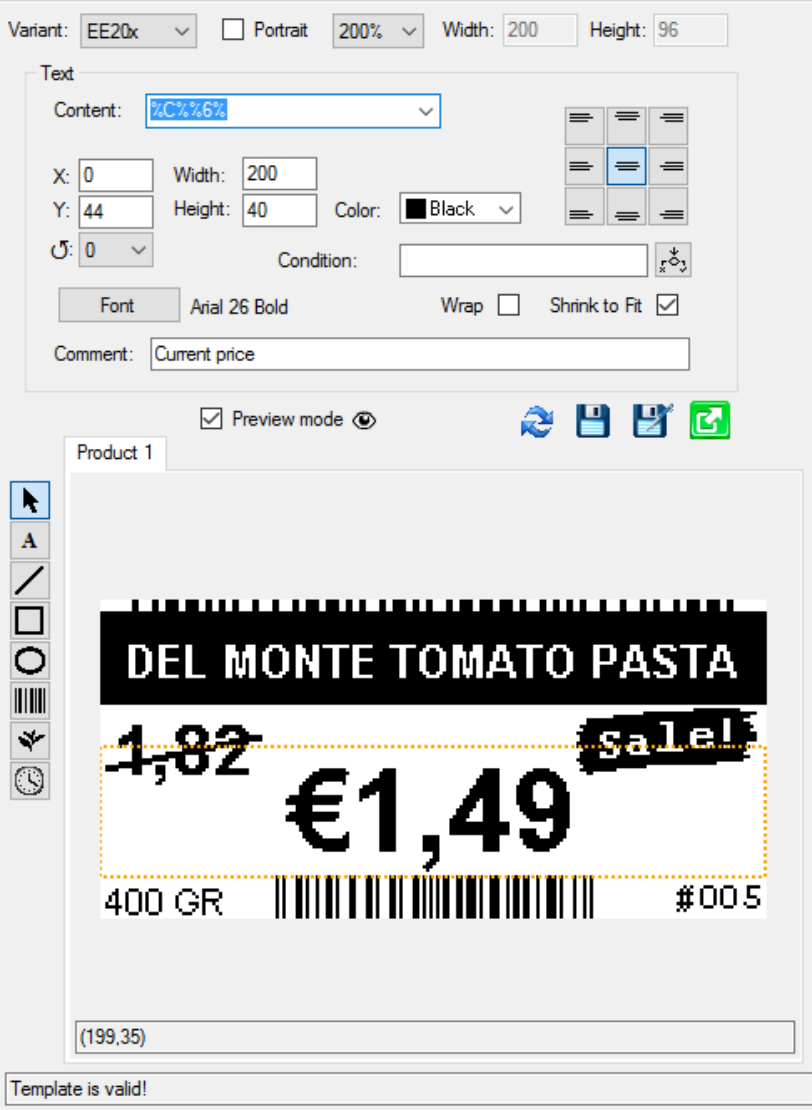
Please note that this new template is still **disabled** to prevent accidentally sending an unfinished template to linked ESLs.

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8.2.   Using the Template editor

Image templates can be created and edited to design your own label layout.

To edit an image layout template, press the [✏️] button next an existing template or press the [New template] - button to create a new template.

The opened template will be displayed on the right.

Click on an object in the template to edit its properties

Image templates currently support 7 types of objects that can be added to design the ESL layout:

	Text (fixed and dynamic)
	Lines
	Rectangles (filled / non-filled)
	Ellipses (filled / non-filled)
	Barcodes
	Images (monochrome or black/white/red; fixed and dynamic)
	Time stamp (of the last image update)
	Back ground LED behavior (PE-Range only)
	Passive NFC content (EE293R NFC only)

To add an object to the template, select the type of object that you want to add, by pressing the corresponding button and draw a rectangle on the image to indicate the position of the new object. After drawing the object its properties can be changed as desired.

To edit an existing object, press the button and left click on the object that you want to edit.

Objects can also be moved by dragging and resized by selecting an object and dragging its borders.

Note: The arrow keys can also be used to move a selected object.

To preview the template, enable to get a realistic view on the result.

8.2.1.   Static and dynamic Content

Static content of barcodes, images and text can be added by typing in the content-box:

Dynamic content is added by specifying a column from your product database using the dropdown-list of the content-box:

It's also allowed to combine static context and/or multiple dynamic contents.

To add a certain column of a database record to your template, add the column number between two '%'-characters in the content field of the object.

Example:

8.2.2.   ESL properties / battery status

It is possible to add properties of an ESL to a template. For example: the battery voltage of the ESL.

The ESL will display the status of this property at the time the image was last generated.

Please note that the ESL server will NOT automatically update the ESL when the battery status (or any other property) changes to avoid increased battery consumption. So, the displayed battery status is the battery status at the time the ESL was last updated.

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Below you will find a list of currently supported ESL properties.

Property	Description
%GROUP%	Group field of the product database
%DESCRIPTION%	Description field of the product database
%POLL_INTERVAL%	Min. poll interval in seconds
%POLL_TIMEOUT%	Poll timeout in polls
%SCAN_INTERVAL%	Associate interval in seconds
%CHANNEL%	RF-channel of the base station
%BATTERY%	Battery voltage / battery icon **
%VARIANT%	Hardware variant of the ESL (i.e. EE201)
%VERSION%	Firmware version of the ESL
%LQI%	Link-Quality-Index measured by the EBS
%LQI_RX%	Link-Quality-Index measured by the ESL
%BASE_STATION%	IP-address of the connected base station
%BOOT_COUNT%	Boot count of the ESL firmware
%LANID%	Configured LAN-ID (0000 is not set)
%PANID%	PAN-ID of the connected base station
%WIDTH%	Width of the ESL display in pixels
%HEIGHT%	Height of the ESL display in pixels

** The accuracy of the measured battery voltage depends on the hardware variant and temperature. Small ESLs (1.5", 2" and 2.9") only have a 0.17V accuracy and use coin cells that will stay at ~3.0V most of their battery life. Larger ESLs with AA or AAA batteries have a more accurate battery voltage and a more linear voltage drop.

8.2.3. Conditional objects

Any type of object can be made conditional, meaning that it is only shown in the resulting image if specified condition is matched (i.e. a certain column contains a certain value).

This can be done by pressing the ⬇ -button next to the 'Condition'-textbox to open the condition editor.

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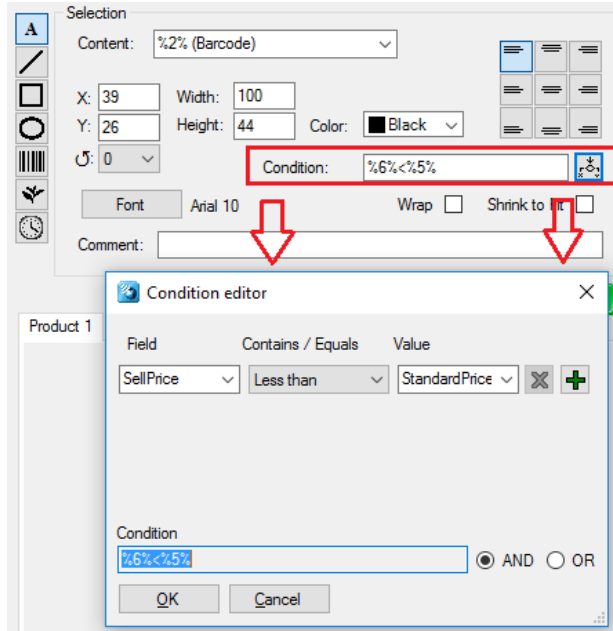
8.3.   Saving and exporting a template

When done editing, press the -button to save the template.

To save an existing under a different name, press the -button.

To undo all unsaved changes, press the -button

When saving a template, you'll be asked whether or not you wish to apply the changed template onto the active ESLs.
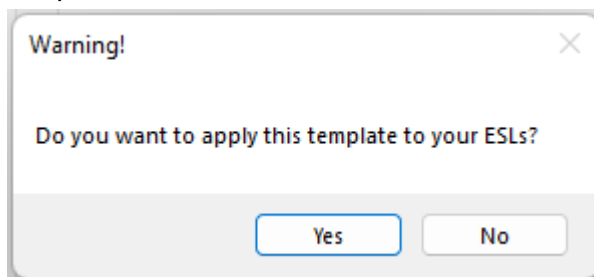
(Note: Make sure the applied template is enabled in the template selection area)

8.4.   Using Example data

The 'Example data' area next to the Template selection provides the possibility to preview the image template with actual product data.
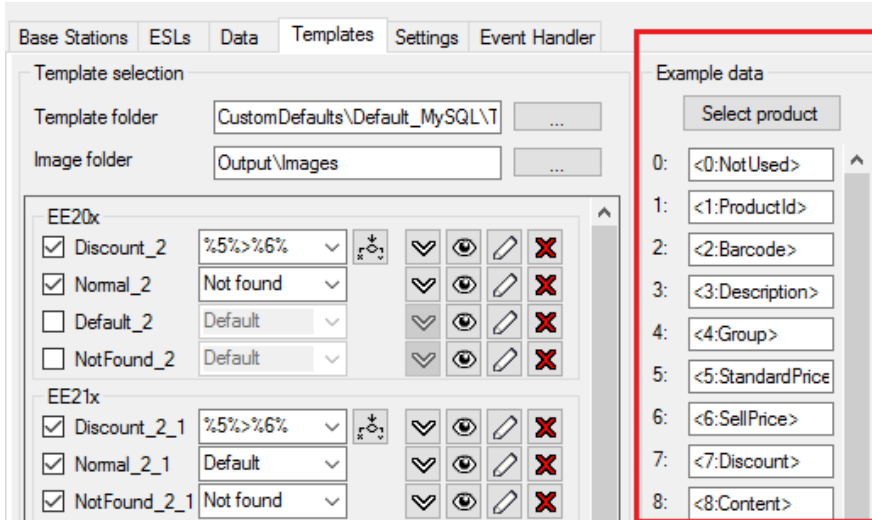
If you leave these 'Example data' fields empty, then the preview of the Image template will show its text 'as is' in the previewer.
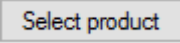
You can either change the 'Example data' manually or you can select one product from the product database by pressing the [Select product]-button. This way you can be sure the generated image will be correct.

Image preview with example data

9. Connecting the back office using CSV-files

The back office triggers the ESL server application by placing a file, containing either only product modifications or a complete product database, in the 'Input' folder (see chapter 7.1).

Only one file may reside in this folder to enforce sequential handling. This means that the Back office may only store another file when the current file has been processed and moved to a different folder.

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To avoid read/write conflicts the database files should first be copied into the specified folder under a temporary name (i.e. *.tmp) and renamed to the correct name afterwards.

The placing and processing of incoming CSV-files should be done as follows:

- The file is moved/copied to a configurable local folder, called the 'Input folder'.
- When moving/copying the file from the Back office to the folder a temporary name is used, i.e. 'productdata_1.tmp', 'productdata_2.tmp', etc.
- After the complete file has been moved or copied, the file will be renamed to its final name, i.e. 'productdata_1.csv', 'productdata_2.csv', etc.

After the file has been placed in the Input-folder, the ESL server will process it as follows:

- The server application will pick up the CSV-file as soon as it detects this rename file event.
- The file will be processed instantly, as the records contain no start/end date.
- Once a file is processed, it will be moved to the configurable 'Processed' folder and the Back-office system is able to put another file in the folder.
- When errors occur, they will be reported in the event log. The data file will not be moved in case of errors.
- The ESL server application will generate the information and image files that are used to update the ESLs.

9.1.   Product database format

Currently the only supported database format is CSV (comma separated values) with the following properties:

- UTF-8, UTF-7, ANSI or Unicode encoding (other encoding formats on request)
- Allowed field separator(s): **semi-colons, commas, pipes, tabs**
- Methods:
    - modification database (add, replace, delete)
    - full database
- Each product in the database must contain a unique product ID field to allow linking of an ESL to a product.
- If there's a 1-to-many relation between the unique product ID and the barcode on this product, then the same product should be added to the database multiple times for each unique barcode, but all other fields must be identical.
- Adding a product barcode field to the database isn't mandatory. However, it is recommended since it adds the possibility to quickly link ESLs to a product by simply scanning the barcodes on the product and the ESL using the barcode terminal.
- If any, a column header line should start with '#'.

When using a modification database, the modification field should be located at the beginning of each line. As modification code the characters 'I' (Insert), 'R' (replace) and 'D' (delete) should be used.

The typical record format of a product modification database would be:

<Modification code>;<Unique ID>;<Barcode>;<Description>;<Field 4>;<Field 5>;etc.

When a **complete database** is used (meaning any new database file replaces the previous one), the **first (modification) field of each line must be left empty**.

The typical record format of a complete product database would be:

;<Unique ID>;<Barcode>;<Description>;<Field 4>;<Field 5>;etc.

Any field that should be displayed on the ESL should be in the same formatting as it should be displayed on the ESL, because the image generator uses the exact field data to render the images.

Note: Database formats other than CSV can be supported but require modifications to the existing middleware application. Please contact Opticon for more information on supporting different database formats.

9.2. Product-ESL link database format

The link between an ESL label and a product is made by linking the unique MAC address of the ESL label to the unique product ID.

To create, modify or delete the product-ESL links various methods can be used:

- Using an Opticon barcode terminal (see chapter 10)

- Using the 'Data'-tab of the ESL server application (see chapter 7.7).

- Using the web application for linking (see chapter 11)

- Using a custom method (i.e. using an existing cash-register or terminal).

All of the above methods work by placing the product-ESL link database in the configured 'Input' folder, which is then automatically processed by the ESL Server application.

This link database is a CSV-file that must contain the word **'link'** in its filename and has the extension **'.csv'** (i.e. 'Product_links1.csv').

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Each record of a **complete link-file** (to replace the existing link database) should have the following exact format:

<Unique ID>;<Hardware variant>;<8- or 16-digit MAC address>

The hardware variant is the product name of the ESL without dashes, so for example: EE201 or EE420R

(legacy) Instead it is also allowed to use the 3rd digit of the software version of an ESL.

For example use: 'D' for the EE202 or 'T' for the EE15x

Example:

001;EE293R;B240018C
002;EE293R;B2400188
003;EE293R;B2400184

Or

007;V;B2400174
008;V;B2400170
009;V;B240016C

Each record of the **modification link-file** should have the following exact format:

<Modification code>;<Unique ID>;<Variant>;<8- or 16-digit MAC address>

When using a **modification link-file**, the allowed modification codes are **'I' (Insert), 'R' (replace)** and **'D' (delete)** should be used.

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When deleting a record, only the MAC address field is mandatory.

Example:

I;003;EE201;B001B633
I;002;EE201;B001B632
D;;;B28000A3

10. Barcode terminal application

An Opticon barcode terminal can be used to link an ESL (using its unique MAC address) to products, objects or locations. How to create these links will be described in the following chapter.

The barcode terminals that are most suitable for this purpose are the OPH1004, OPH1005, H13, and OPH300x, in combination with a communication cradle or USB cable.

Also, the OPN2002/4/5/6 and PX20 can be used for quick linking using only barcodes, but place keep in mind that this terminal does not have a display for detailed feedback or a keyboard for manual editing.

Alternatively, the most common method of linking is using the supplied Web application for linking that can be used on almost any barcode terminal with Wi-Fi and a web browser, like the H21, H22 or H32. This is done by installing a local HTTP-server on the ESL server to the web application for linking and monitoring. See chapter 11 for more information.

10.1. Setting up the barcode terminal

When using the USB-cable it's necessary to install Opticons USB driver pack, which can be selected in the installer. The drivers can also be found in the 'Tools' folder of this installation.

If the 'ESL Linking Application' is not yet loaded on the terminal or needs to be updated, then the software can be loaded by using the 'Update Firmware' option in the 'Setup' window of the ESL server manager. *

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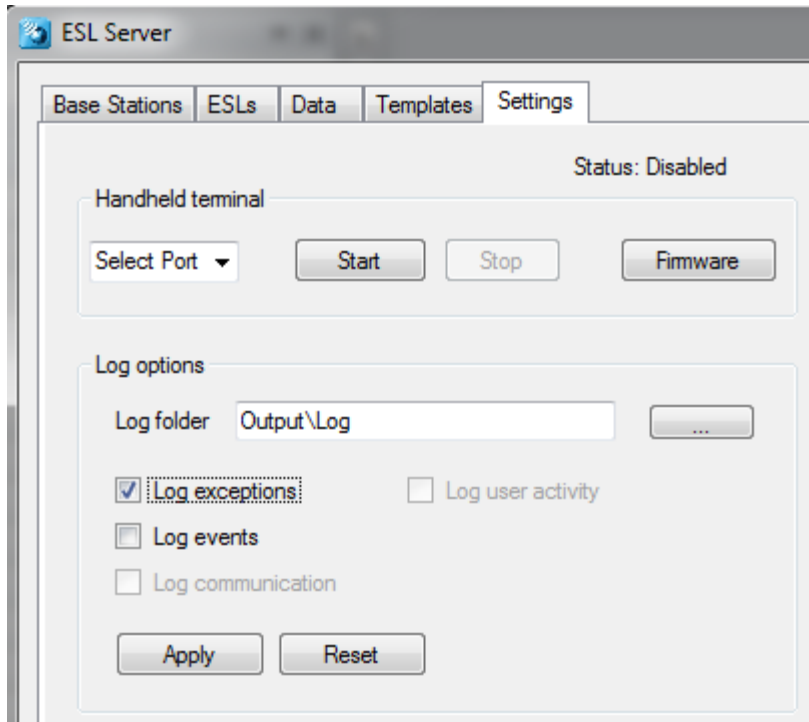
To load the software, open the 'Setup'-tab of the ESL server application. Make sure you've selected the correct COM port. Then press the 'Update Firmware' button and select the correct firmware file, being:

- 'OPH1004_H13_XPA3693x.HEX' for the OPH1004/H13

- 'OPL9728_LBF3693x.S32' for the OPL9728

- 'OPL9815_XFO3693x.hex' for OPL9815

- 'OPN2002_3_RFG3693x.hex' for the OPN2002 / OPN2003

- 'OPN2004_5_6_RFI3693x.hex' for the OPN2004 / OPN2005 / OPN2006

- 'OPH3000_XFM3693x.hex' for OPH3000/CLK3000

- 'OPH1005_XFP3693x.hex' for OPH1005

These files can be found in the 'Firmware' folder of this installation.

* Note: Updating the firmware of the barcode terminal can also be done using Appload. Appload can be installed by selecting 'Appload' in the installer or it can be found in the 'Tools' folder.

10.2.   Loading the database files on the terminal

Before any links can be created, the reduced product database (scan.csv) first must be loaded on the terminal to allow the reading of the barcodes on product.

To be able to transfer files between the ESL server application and the barcode terminal the serial port of the PC is used. Make sure you've enabled and configured the correct serial port in the 'Setup'-tab in the server application.

Also verify that the field numbers of the unique ID, barcode and description match your CSV-database file (See chapter 7.1). Note that the first field is field number 0; the second is 1, etc.

Loading any files onto the terminal and sending back the resulting link database is done by placing the terminal into its cradle. As soon as the combined article database (scan.csv) or the link database has been changed, the server application will automatically synchronize the barcode terminal with the PC and process any modifications using the OseComm protocol.

When using the OPN200x or OPH300x with USB, then the file exchange must be started manually

10.3.   Creating links between ESLs and products

To create a link between an ESL and a product, the barcode on the back of an ESL needs to be scanned.

If the barcode on the e-paper ESLs is not accessible, it's also possible to display this same barcode on the e-paper ESLs. To do so, select all ESLs in the 'ESLs'-tab that have not yet been linked, then select the 'Show default image' action and press the 'Start' button. All ESLs should now start displaying the (default) barcode image containing the MAC address.

Note: The barcode on the ESL is truncated to fit the display, meaning that the first 6 or 9 digits ('3889DC or '3889DC000') have been replaced by the letter 'B'.

For re-linking and unlinking of ESLs that already show a product, it's also possible to add the MAC address barcode to your template file, by adding a small bar at the top of the template containing this barcode. See chapter 8.2.1 for more information.

10.3.1. OPH100x, H13, OPH3000, OPL9728 or OPL9815

Make sure the correct firmware version is loaded on the terminal:
- 'OPH1004_H13_XPA3693x.HEX' for the OPH1004/H13
- 'OPL9728_LBF3693x.S32' for the OPL9728
- 'OPL9815_XFO3693x.hex' for OPL9815
- 'OPH3000_XFM3693x.hex' for OPH3000/CLK3000
- 'OPH1005_XFP3693x.hex' for OPH1005

Then press '1' (Link ESLs) to start linking ESLs.

To create a link, first scan the MAC address barcode on the ESL followed by entering or scanning the unique ID or barcode of the product that you want to link to this ESL.

After scanning/entering the product, the terminal should say that the linking was successful ('Linking successful'). If the product wasn't found in the database, it will show a message that the product wasn't found ('Product not found').

If you accidentally linked the wrong product to an ESL, then you can correct this by scanning the ESL's MAC address again and linking it to the correct product.

Settings:
The settings menu of the terminal can be accessed by pressing '4' ('Settings). This menu contains 2 options:

1. **Delete data**   Deletes all files from the terminal, so also all links that have not yet been sent back to the PC.
2. **Barcodes**   This menu can enable/disable different barcode symbologies, so almost all barcodes can be scanned.

Version:
Shows the version of the terminal application, which can be useful for support purposes.

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10.3.2. OPN2002/3/4/5/6

Make sure the correct firmware version is loaded on the terminal:

- 'OPN2002_3_RFG3693x.hex' for the OPN2002 / OPN2003
- 'OPN2004_5_6_RFI3693x.hex' for the OPN2004 / OPN2005 / OPN2006

To create a link, press the trigger button and scan the product barcode.

If the product wasn't found in the database (or no database was present) it will sound an error beep to indicate the product wasn't found.

If the product is found, the laser will stay on and will start beeping every second to indicate that you can now scan MAC address of the ESL.

After scanning the MAC address an OK-beep will be given to indicate that the linking was successful.

To delete an existing link, press the small button and scan the MAC address of the ESL. The OPN200x will either sound an OK-beep or an error-beep indicating the unlinking was successful or not.

+-FORMAT-+	Format Disk
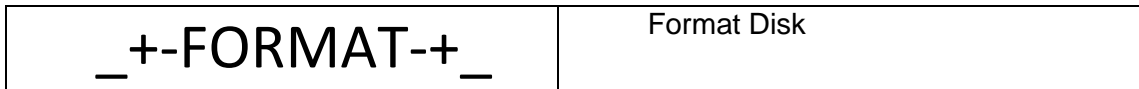
* Note: Use the format label to erase all data from the OPN200x, in case you wish to start over.

10.4. Sending the link file back to the PC

After all links have been created using the barcode terminal, this information needs to be sent back to the PC, so they can be processed by the server application. This can be done by placing the terminal back into its cradle (or connecting it to a USB-cable). The terminal should now automatically send the link database (linked.csv) back to the PC.

After the barcode terminal has sent back the link database, the ESL server application will parse the product database and link database into image files and update the ESLs if necessary.

Note: When using the OPN200x or OPH300x with USB, then the file exchange has to be started manually by pressing the 'Start' button on the ESL server in the 'Settings'-tab.

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11. Using the Web Application for linking and monitoring

It is also possible to use the H21, H22, H32 or any other Wi-Fi terminal to link ESL to products and monitor the ESL system using a Wi-Fi connection. This is done by installing a local webserver on the ESL server to run a web page to perform the linking.

During installation, make sure you've checked the option 'Install web application'. This will install the web application into the 'WebApp-Full' sub-directory of the ESL server installation.

The easiest way to set up a local HTTP-server is by installing XAMPP during the ESL Server installation process. This process will set ESL Server to connect on port 8015, instead of the often-occupied port 80. If you want to change this port, use the XAMPP control panel.

The Web application should now be running. Open any web browser and enter 'http:\\localhost:8015' to see the web application.

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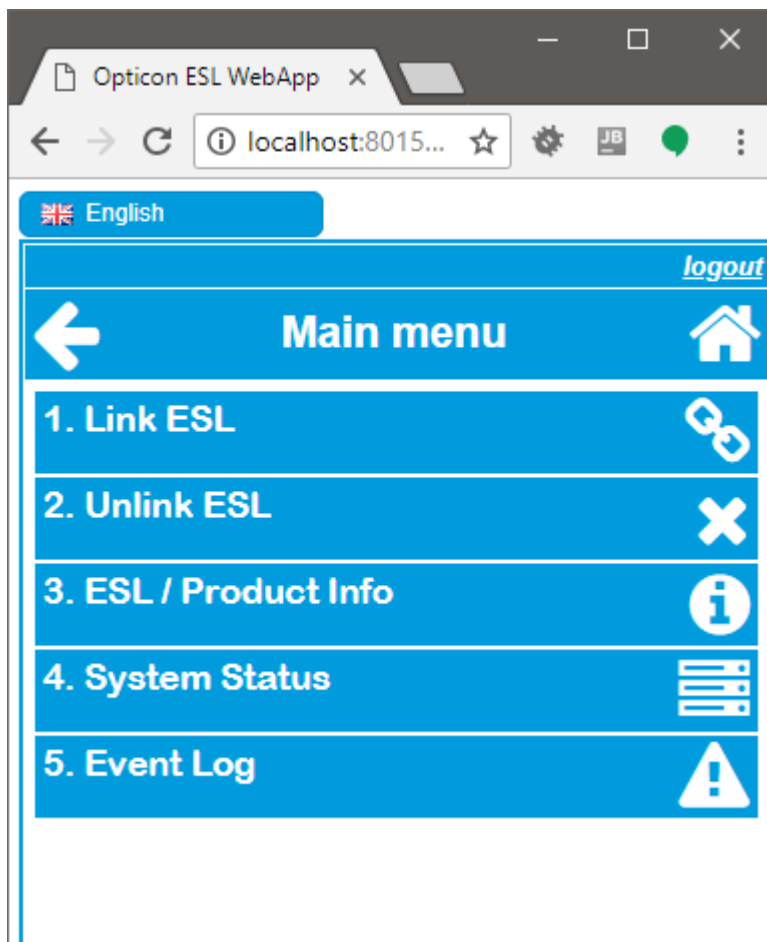
The Web-application should be automatically configured by the ESL server to match the configuration of the ESL server itself. If this is not the case, please verify that the Source folder of the Web application is correctly configured in the Data-tab.

Check that the URL has the correct port. No specifier means port 80.

11.1.   Web application with Oracle, Postgres, FireBird, SQLite, MS-SQL and DB2

When using the web application with these databases it is recommended to use an ODBC.

If the ESL server connects to the database without ODBC, but the web application uses an ODBC data source, then this DSN can be configured in the 'Web application'-tab as shown below.

Be aware that it is important that the ODBC data source needs the same architecture as the HTTP-server. This means that a 32-bit HTTP-server requires a 32-bit ODBC driver/data source.

See chapter 7.3 for more information on how to set-up an ODBC connection.

12. Running the ESL server as service

To make sure the ESL server will always run in the background and can't be closed accidently, the ESL server can also be configured to run as service.

To run the ESL server as service, **run the ESL server as administrator** and go to the 'Settings-tab and enable the option: 'Run as Service'.

Secondly, the Windows account details on which the ESL server has been installed need to be filled in. This makes sure that the ESL service will run under the same Windows

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account and will use the same configuration file when it's started manually with GUI (Graphical User Interface)

The shutdown time out of the service can be increased when closing generally takes longer than 15 seconds, i.e. when using a slow PC or when SQL is used in combination with a remote SQL server.

The service will be installed after pressing the 'Install' button and will start running as soon as the ESL server application is closed or after the PC has been rebooted.

After that, the ESL service will automatically be stopped (and restarted afterwards) when the ESL server is started with GUI.

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Appendix A: Demo barcodes

The quickest way to set up an ESL demonstration with barcode terminal is to simply use the included sample database and example templates. After installation of the software and hardware, the only configuration steps necessary are finding and adding of the base station and configuring the serial port of the barcode terminal.

The example database file will automatically be sent to the barcode terminal and then you can link your ESLs using the barcode terminal and the product barcodes in the images below. (See chapter 10).

BONDUELLE CARROTS €0.95 180 GR #001 001	**BOND BUNTER MIX** ~~1.29~~ €0.89 -31% 400 GR #003 003	**BOND APPEL COMPOTE** €0.79 150 GR #004 004	**DOLE PINEAPPLE ON JUICE** €1.75 680 GR #006 006_00124B00010DB203.bmp
FRUCTIS 2 IN 1 SHAMPOO €3.80 300 ML #008 008	**NIVEA FOR MEN SPORT** ~~3.95~~ €2.95 -25% 250 ML #010 010	**SWARZKOPF JUNIOR STYLING** ~~4.50~~ €3.99 -11% 250 ML #011 011	**GILLETTE SHAVING FOAM** €6.99 200 ML #012 012_00124B00010DAA9D.bmp
GILLETTE SHAVING FOAM €6.99 200 ML #012 012_00124B00010DC906.bmp	**PRODENT TOOTHPASTE** €2.05 75 ML #013 013	**AQUAFRESH TOOTHPASTE** €1.80 75 ML #014 014_00124B00010DB1EF.bmp	**AQUAFRESH TOOTHPASTE** €1.80 75 ML #014 014
COLGATE SENSATION WHITE €2.29 75 ML #015 015	**ELMEX TOOTHPASTE** ~~1.65~~ €1.19 -28% 75 ML #016 016	**ELMEX TOOTHPASTE** ~~1.65~~ €1.19 -28% 75 ML #016 016	**PICKWICK FOREST FRUIT** €1.29 40 GR #017 017
PICKWICK TEA MINT €1.29 40 GR #018 018	**PICKWICK TEA MINT** €1.29 40 GR #018 018	**PICKWICK TEA LEMON** €0.89 30 GR #019 019	**FOLGERS CLASSIC ROAST** ~~2.99~~ €2.48 -17% 250 GR #020 020

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Appendix B: MySQL demo configuration

The ESL Server installation contains example queries to quickly set-up a demo with MySQL. The example query can be found in the following folder of your installation.

- '/Examples/MySQL'

Use PhpMyAdmin to create a database called 'esl' and use the following configuration in the ESL server:

After making the configuration, use the 'Test'-button to test the connection details.

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If the connection was successful, then press 'Apply' to save the settings.

To create the product tables, use the Import-button to 'Import' the query-file:

- '/Examples/MySQL/products_mysql.sql'

The product data should now appear in the Data-tab.

Product changes can now be made:

- Manually by editing the products in the Data-tab
- By placing a compatible CSV-file in the configured Input-folder, which can be found here:

'/Examples/CSV/products.csv'

- Using the provided full web application (price changes only)
- Automatically by placing product changes into the 'product staging' table

See chapter 11 for more information on using the full Web application.

See 'Appendix A: Demo barcodes' to demonstrate easy linking using EAN/UPC barcodes and a barcode scanner.

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Appendix C: MS-SQL demo configuration

The ESL Server installation contains example queries to quickly set-up a demo with MS-SQL. The example query can be found in the following folder of your installation.

- '/Examples/MS-SQL'

Use SQL Server management studio to create a database called 'ESL' and use the following configuration in the ESL server:

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After making the configuration, use the 'Test'-button to test the connection details.

If the connection was successful, then press 'Apply' to save the settings.

To create the product tables, use the Import-button to 'Import' the query-file:

- '/Examples/MS-SQL/products_mssql.sql'

The product data should now appear in the Data-tab.

Product changes can now be made:

- Manually by editing the products in the Data-tab
- By placing a compatible CSV-file in the configured Input-folder, which can be found here:

'/Examples/CSV/products.csv'

- Automatically by placing product changes into the 'product staging' table

See chapter 11 for more information on using the Web application for linking and monitoring.

See 'Appendix A: Demo barcodes' to demonstrate linking products using EAN/UPC barcodes

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Appendix D: Oracle demo configuration

The ESL Server installation contains example queries to quickly set up a demo with Oracle. The example query can be found in the following folder of your installation.

- '/Examples/Oracle'

Create a database called ESL and Open an SQL Worksheet in Oracle SQL developer and use the following configuration in the ESL server:

After making the configuration, use the 'Test'-button to test the connection details.

If the connection was successful, then press 'Apply' to save the settings.

To create the product tables, use the Import-button to 'Import' the query-file:

- '/Examples/Oracle/products_oracle.sql'

The product data should now appear in the Data-tab.

Product changes can now be made:

- Manually by editing the products in the Data-tab
- By placing a compatible CSV-file in the configured Input-folder, which can be found here:

'/Examples/CSV/products.csv'

- Automatically by placing product changes into the 'product staging' table

See chapter 11 for more information on using the Web application for linking and monitoring.

See 'Appendix A: Demo barcodes' to demonstrate linking products using EAN/UPC barcodes

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Appendix E: PostgreSQL demo configuration

The ESL Server installation contains example queries to quickly set-up a demo with PostgreSQL. The example query can be found in the following folder of your installation.

- '/Examples/PostgreSQL'

Create a database called 'esl' in a PostgreSQL editor, i.e. pgAdmin, and use the following configuration in the ESL server:

After making the configuration, use the 'Test'-button to test the connection details.

If the connection was successful, then press 'Apply' to save the settings.

To create the product tables, use the Import-button to 'Import' the query-file:

- '/Examples/PostgreSQL/products_pgsql.sql'

Product changes can now be made:

- Manually by editing the products in the Data-tab
- By placing a compatible CSV-file in the configured Input-folder, which can be found here:

'/Examples/CSV/products.csv'

- Automatically by placing product changes into the 'product staging' table

See chapter 11 for more information on using the Web application for linking and monitoring.

See 'Appendix A: Demo barcodes' to demonstrate linking products using EAN/UPC barcodes

Appendix F: SQLite demo configuration

When using SQLite, the SQLite database will be automatically generated in the installation folder of the ESL server.

Use the following configuration in the ESL server. (Username and password are ignored)

After making the configuration, use the 'Test'-button to test the connection details.

If the connection was successful, then press 'Apply' to save the settings.

To create the product tables, use the Import-button to 'Import' the query-file:

- '/Examples/SQLite/products_sqlite.sql'

The product data should now appear in the Data-tab.

Since SQLite is file based, accessing the database file from a 3rd party application can result in locked database errors. Therefor it is recommended to apply changes to the product and link table using CSV-files.

A compatible CSV-file for this demo product table can be found here:

- '/Examples/CSV/products.csv'

This file can be imported using the 'Import'-button or by placing it in the configured Input-folder.

See chapter 11 for more information on using the Web application for linking and monitoring.

See 'Appendix A: Demo barcodes' to demonstrate linking products using EAN/UPC barcodes

Appendix G: DB2 demo configuration

When using DB2, it is mandatory to create an ODBC data source (i.e. called DB2_ODBC_ESL) to connect to the DB2 database. See chapter 7.3 for more information on ODBC.

Use the following configuration in the ESL server.

After making the configuration, use the 'Test'-button to test the connection details.

If the connection was successful, then press 'Apply' to save the settings.

To create the product tables, use the Import-button to 'Import' the query-file:

- '/Examples/DB2/products_db2.sql'

The product data should now appear in the Data-tab.

A compatible CSV-file for this demo product table can be found here:

- '/Examples/CSV/products.csv'

This file can be imported using the 'Import'-button or by placing it in the configured Input-folder.

See chapter 11 for more information on using the Web application for linking and monitoring.

See 'Appendix A: Demo barcodes' to demonstrate linking products using EAN/UPC barcodes

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Appendix H: Firebird demo configuration

The ESL Server installation contains example queries to quickly set-up a demo with PostgreSQL. The example query can be found in the following folder of your installation.

- '/Examples/Firebird'

Create a FireBird 3.0 database file called 'ESL.FDB' in a FireBird editor, i.e. using ISQL or RedExpert, and use the following configuration in the ESL server (change path to file if needed):

After making the configuration, use the 'Test'-button to test the connection details.

If the connection was successful, then press 'Apply' to save the settings.

To create the product tables, use the Import-button to 'Import' the query-file:

- '/Examples/FireBird/products_firebird.sql'

Product changes can now be made:

- Manually by editing the products in the Data-tab
- By placing a compatible CSV-file in the configured Input-folder, which can be found here:

'/Examples/CSV/products.csv'

- Automatically by placing product changes into the 'product staging' table

See chapter 11 for more information on using the Web application for linking and monitoring.

See 'Appendix A: Demo barcodes' to demonstrate linking products using EAN/UPC barcodes

Appendix I: Restoring the ESL server back to default (CSV)

The ESL Server can be reverted to factory default by importing a configuration file found in the following folder of your installation.

- '/Examples/Default Configuration'

Be aware that any changed configurations, changes to the templates and to the CSV database will be lost in the process!

Use the Import-button in the 'Data'-tab to 'Import' the config-file:

- '/Examples/Default Configuration/ESL Server.config'

After importing the configuration file, the ESL server will be restored back to factory default.

Restart the ESL server to apply all changes.

Appendix J: Using the SQL API

SQL queries can be used as API to create your own application by executing SQL queries to control and monitor the ESL system, while running the ESL server as background service (See chapter 12 on how run the ESL server as service).

See chapter 7.2 for information on how to use the product and link staging tables to update ESLs and status tables to monitor the ESL system remotely.

Besides the SQL tables described in chapter 7.2, the ESL server also automatically creates the following 3 SQL tables to allow control over the ESL server using SQL queries.

- **Actions_staging**: Staging table used to insert new actions that need to be executed.

ACTION	varchar(32)	utf8_general_ci	Geen	🔑
MAC	varchar(16)	utf8_general_ci	Geen	🔑
USER	varchar(64)	utf8_general_ci	NULL	
PARAM1	varchar(32)	utf8_general_ci	NULL	
PARAM2	varchar(32)	utf8_general_ci	NULL	
PARAM3	varchar(32)	utf8_general_ci	NULL	
TIME	datetime		NULL	

- **Actions_pending**: Actions that involve commands that need to be send to ESLs are moved from the staging table to this table to indicate that the command is queued and will be sent as soon as the ESL wakes up.

ACTION	varchar(32)	utf8_general_ci	Geen	🔑
MAC	varchar(16)	utf8_general_ci	Geen	🔑
USER	varchar(64)	utf8_general_ci	NULL	
PARAM1	varchar(32)	utf8_general_ci	NULL	
PARAM2	varchar(32)	utf8_general_ci	NULL	
PARAM3	varchar(32)	utf8_general_ci	NULL	
TIME	datetime		NULL	

- **Actions_results**: All actions that have immediate result will be moved from the staging table to this table. This includes base station commands and failed ESL commands.

ACTION	varchar(32)	utf8_general_ci	*Geen*	🔑
MAC	varchar(16)	utf8_general_ci	*Geen*	🔑
USER	varchar(64)	utf8_general_ci	*NULL*	
PARAM1	varchar(32)	utf8_general_ci	*NULL*	
PARAM2	varchar(32)	utf8_general_ci	*NULL*	
PARAM3	varchar(32)	utf8_general_ci	*NULL*	
TIME	datetime		*NULL*	
RESULT	varchar(256)	utf8_general_ci	*NULL*	

Supported ESL actions

The following list of SQL-commands is currently supported to initiate an ESL action. Valid commands will be moved to the action_pending table. Discarded commands will be moved to the action_results table

ACTION	MAC	PARAM1
RESET	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('RESET', 'B000A842');		
DEFAULT_IMAGE	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('DEFAULT_IMAGE', 'B000A842');		
REFRESH_IMAGE	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('REFRESH_IMAGE', B000A842);		
RESEND_IMAGE	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('RESEND_IMAGE', B000A842);		
REQUEST_SETTINGS	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('REQUEST_SETTINGS', B000A842);		
UNLINK	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('UNLINK', B000A842);		
DELETE	MAC-Address (8)	(Unlink & remove ESL from status table)
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('DELETE', B000A842);		
REASSOCIATE	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('REASSOCIATE', B000A842);		
KICK_FROM_EBS	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('KICK_FROM_EBS', B000A842);		
MOVE_TO_EBS	MAC-Address (8)	MAC-Address EBS (12)
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('MOVE_TO_EBS', B000A842, '00126AF5001234');		
SET_LANID	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('SET_LANID', B000A842);		

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CLEAR_LANID	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('CLEAR_LANID', B000A842);		
DEACTIVATE	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('DEACTIVATE', B000A842);		
FACTORY_DEFAULT	MAC-Address (8)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('FACTORY_DEFAULT', B000A842);		
CHANGE_MAC_ADDRESS	MAC-Address (11)	MAC-Address (new) (8) (For factory only)
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('CHANGE_MAC_ADDRESS', 'A00149F203D', B000A842);		

Supported ESL settings

The following list of SQL-commands is currently supported to change ESL settings. Valid commands will be moved to the action_pending table. Discarded settings and settings that match the current setting will be moved to the action_results table.

ACTION	MAC	PARAM1 (default; min; max)	
POLL_INTERVAL (int)	MAC-Address (8)	Min. poll interval in seconds (**20**, 5, 200)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('POLL_INTERVAL', B000A842, 20);			
POLL_TIMEOUT (int)	MAC-Address (8)	Poll timeout in polls (**10**, 5, 30)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('POLL_TIMEOUT', B000A842, 20);			
SCAN_INTERVAL (int)	MAC-Address (8)	Associate interval in seconds (**60**,60,300)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('SCAN_INTERVAL', B000A842, 60);			
DISPLAY_OPTIONS (int)	MAC-Address (8)	**0: normal**, 1: upside down	
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('DISPLAY_OPTIONS', B000A842, 1);			
SCAN_CHANNELS (flags)	MAC-Address (8)	11: 0x00000800 12: 0x00001000 13: 0x00002000 14: 0x00004000 15: 0x00008000 16: 0x00010000 17: 0x00020000 18: 0x00040000	19: 0x00080000 20: 0x00100000 21: 0x00200000 22: 0x00400000 23: 0x00800000 24: 0x01000000 25: 0x02000000 26: 0x04000000

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INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('SCAN_CHANNELS', B000A842, '101746688'); (0x06108800 = 11, 15, 20, 25, 26)		
TEMPERATURE	MAC-Address (8)	Temperature range. (0=default; 0, 4) (>0 values are to compensate for lower temperatures, but shorten battery life)
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('TEMPERATURE', B000A842, 0);		

Supported Base station actions

The following list of SQL-commands is currently supported to initiate a base-station-action. Successfully executed and discarded commands will be moved to the action results-table.

ACTION	MAC	PARAM1
REACTIVATE_START	MAC-Address (12)	Timeout in sec (min 30, max 900)
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('REACTIVATE_START', '00126AF5FFF8', 180);		
REACTIVATE_STOP	MAC-Address (12)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('REACTIVATE_STOP', '00126AF5FFF8');		
DEACTIVATE	Start range (MAC-Address (8)	End range (MAC-Address 8)
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('DEACTIVATE', 'B1000000', 'B100FFFF');		
DISCOVER		
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('DISCOVER', '');		
BALANCE_ESLS		(Use preferably once a day)
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('BALANCE_ESLS', '');		
REFRESH_ESLS		(Warning: Refreshing effects battery life!)
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('REFRESH_ESLS', '');		
RESET	MAC-Address (12)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('RESET', '00126AF5FFF8');		
ADD	MAC-Address (12)	
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('ADD', '00126AF5FFF8');		
REMOVE		
INSERT INTO `actions_staging`(`ACTION`, `MAC`) VALUES ('REMOVE', '00126AF5FFF8');		
FIRMWARE_UPDATE		
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('FIRMWARE_UPDATE', '00126AF5FFF8', 'EBS40-IBUV0052.bin');		

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Supported Base station settings

The following list of SQL-commands is currently supported to change a base-station-setting. Successfully executed and discarded commands will be moved to the action results-table.

ACTION	MAC	PARAM1
CHANNEL	MAC-Address (12)	RF-Channel (int) (**default 11**, min 11, max 26)
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('CHANNEL','00126AF5FFF8',15);		
PANID	MAC-Address (12)	PAN-ID (4) (default: last 4 digits of MAC)
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('PANID','00126AF5FFF8','12AB');		
LANID	MAC-Address (12)	LAN-ID (4) (**default 0000**,min 0000,max FFFE)
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('LANID','00126AF5FFF8','0003');		
LOCAL_NAME	MAC-Address (12)	LAN-ID (4) (**default 0000**,min 0000,max FFFE)
INSERT INTO `actions_staging`(`ACTION`, `MAC`, `PARAM1`) VALUES ('LOCAL_NAME','00126AF5FFF8','FIRST_FLOOR');		

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Appendix K: REST API commands

The ESL Server can host a web service on port 8791 with a REST API to control and monitor the ESL system (See chapter REST API for more information)

POST & DELETE requests for ESLs

The following list of POST and DELETE commands are currently supported to initiate an ESL action.

ACTION	MAC	PARAM1
RESET	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/RESET		
DEFAULT_IMAGE	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/DEFAULT_IMAGE		
REFRESH_IMAGE	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/REFRESH_IMAGE		
RESEND_IMAGE	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/RESEND_IMAGE		
REQUEST_SETTINGS	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/REQUEST_SETTINGS		
LINK	MAC-Address (8)	ID/Barcode from product
POST http://localhost:8791/ESL/{MAC}/LINK/{ID}		
UNLINK	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/UNLINK or DELETE http://localhost:8791/ESL/{MAC}/LINK		
DELETE	MAC-Address (8)	Unlink and remove from status table
DELETE http://localhost:8791/ESL/{MAC}		
REASSOCIATE	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/REASSOCIATE		
KICK_FROM_EBS	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/KICK_FROM_EBS		
MOVE_TO_EBS	MAC-Address (8)	MAC-Address EBS (12)
POST http://localhost:8791/ESL/{MAC}/MOVE_TO_EBS/{EBS}		
SET_LANID	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/SET_LANID		
CLEAR_LANID	MAC-Address (8)	
DELETE http://localhost:8791/ESL/{MAC}/LANID		
DEACTIVATE	MAC-Address (8)	

POST http://localhost:8791/ESL/{MAC}/DEACTIVATE		
FACTORY_DEFAULT	MAC-Address (8)	
POST http://localhost:8791/ESL/{MAC}/FACTORY_DEFAULT		
CHANGE_MAC_ADDRESS	MAC-Address (11)	MAC-Address (new) (8) (For factory only)
POST http://localhost:8791/ESL/{MAC}/CHANGE_MAC_ADDRESS/{NEW_MAC}		

(PE-Range only; requires firmware version Ixxx0150 or higher)

LED	MAC-Address (8)	{LED setting: 1(store), 0(no store)} {Led mode & color} {Duty cycle parameters}
GET http://localhost:8791/ESL/{MAC}LED (status of last command)		
POST http://localhost:8791/ESL/{MAC}/LED/{setting}/FLASH|RED/2000|50|15		
0 = LED setting is not remembered when power is removed; 1=LED setting is remembered *ON Continuously on (duty cycle parameters are ignored)* *FLASH Flashing, using specified duty cycle parameters* *RED / GREEN / BLUE / ORANGE / PURPLE / CYAN Specifies the LED color* *<period>|<ON %>|<nr. of periods>* *Example: 2000|50|15 = 2000ms period, 50% on, flash 15 times*		
SOUND	MAC-Address (8)	{Tone duration in ms} {volume} {comma-separated tones in Hz}
GET http://localhost:8791/ESL/{MAC}/SOUND (status of last command)		
POST http://localhost:8791/ESL/{MAC}/SOUND/130/HIGH/{tones}		
Freq. range: 1000hz – 5000hz. (Max: 20 notes) *Volume range: VERY_LOW / LOW / STANDARD / MEDIUM / HIGH* Example: http://localhost:8791/ESL/{MAC}/SOUND/130/HIGH/1318,1567,2637,2093,2349,3135		
MIDI_SOUND	MAC-Address (8)	{volume} {RTTTL-format}
POST http://localhost:8791/ESL/{mac}/MIDI_SOUND/0/{volume}/{RTTTL-tune}		
Notes range: B5 – D#8 (988Hz – 4978Hz) (Max: 40 notes) *Volume range: VERY_LOW / LOW / STANDARD / MEDIUM / HIGH* *https://en.wikipedia.org/wiki/Ring_Tone_Transfer_Language* Example: MIDI_SOUND/0/VERY_LOW/simpsons:d=4,o=5,b=160:c.6,e6,fs6,8a6,g.6,e6,c6,8a,8fs,8fs,8fs,2g *Note 1: `#` need to be replaced by `s` due to URL-format* *Note 2: Octave is automatically increased if notes fall outside freq. range*		

The following list of POST commands are currently supported to change ESL settings.

ACTION	MAC	PARAM1 (default; min; max)	
POLL_INTERVAL (int)	MAC-Address (8)	Min. poll interval in seconds (**20**, 5, 200)	
POST http://localhost:8791/ESL/{MAC}/POLL_INTERVAL/{Value}			
POLL_TIMEOUT (int)	MAC-Address (8)	Poll timeout in polls (**10**, 5, 30)	
POST http://localhost:8791/ESL/{MAC}/POLL_TIMEOUT/{Value}			
SCAN_INTERVAL (int)	MAC-Address (8)	Associate interval in seconds (**60**, 60, 300)	
POST http://localhost:8791/ESL/{MAC}/SCAN_INTERVAL/{Value}			
DISPLAY_OPTIONS (int)	MAC-Address (8)	**0: normal**, 1: upside down	
POST http://localhost:8791/ESL/{MAC}/DISPLAY_OPTIONS/{Value}			
SCAN_CHANNELS (flags)	MAC-Address (8)	11: 0x00000800 12: 0x00001000 13: 0x00002000 14: 0x00004000 15: 0x00008000 16: 0x00010000 17: 0x00020000 18: 0x00040000	19: 0x00080000 20: 0x00100000 21: 0x00200000 22: 0x00400000 23: 0x00800000 24: 0x01000000 25: 0x02000000 26: 0x04000000
POST http://localhost:8791/ESL/{MAC}/SCAN_CHANNELS/{Value}			
Example: Value = 0x06108800 = 11, 15, 20, 25, 26			

GET requests for ESLs

The following GET-requests are currently supported to get the status and configurations of all or a single ESL.

ACTION	MAC	PARAM1 (default; min; max)
GET http://localhost:8791/ESL		
	MAC-Address (8)	
GET http://localhost:8791/ESL/{MAC}		
	MAC-Address (8)	Name of the setting/variable
GET http://localhost:8791/ESL/{MAC}/{Variable}		

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Variable	Description
ID	Unique article ID to which the ESL is linked. <Null> or empty if the ESL is/was present in the ESL system, but not linked.
DESCRIPTION	If ESL is linked, this field will contain the configured product description. <Null> if not linked or unknown
IMAGE_FILE	If ESL is linked, this field will contain the file name of the automatically generated image content. <Null> if not linked.
POLL_INTERVAL	If ESL is physically present, this field will contain the poll interval of the ESL. <Null> if the poll interval is unknown
POLL_TIMEOUT	If ESL is physically present, this field will contain the poll timeout of the ESL. <Null> if the poll timeout is unknown
SCAN_INTERVAL	If the ESL is physically present, this field will contain the scan/associate interval of the ESL. <Null> if the interval is unknown.
BATTERY_STATUS	If the ESL is physically present, this field will contain the battery status of the ESL. (Full=1; Almost full=2; half full=4; low=8, Empty=16, Unknown / N.A. = 32 or NULL)
VARIANT	If the ESL is physically present or linked, this field will contain the hardware variant of the ESL (I.e.EE201) <Null> = Unknown
FIRMWARE_VERSION	This field will contain the software version of the ESL. Typically, in the format: IxxVyyyy. <Null> = Unknown
SUB_VERSION	This field will contain the software subversion of the ESL. Typically, not used by e-paper based ESLs. <Null> = Unknown
IMAGE_ID	This field will contain the image ID of the image shown on the ESL. 0=default image; 1=custom Image; <Null> = Unknown. In the future the ESLs can contain multiple images.
BACKLIGHT	If ESL is physically present, this field will contain the back light setting (ranging from 5-100(%), <Null> = unknown). Only used by TFT based ESLs
DISPLAY_OPTIONS	If ESL is physically present, this field will contain the orientation of the image. 0=Normal, 1=Upside-down, <Null> = unknown
LQI	This field will contain the last received Link-Quality-Index, indicating the connection strength with the base station. -1 Unknown / not connected 0-3 Link quality is poor and high packet loss (>40%) 4-7 Link quality is poor and significant packet loss (>20%) 8-10 Link quality is poor, but no significant packet loss (<20%) >10 Link quality is good and no significant packet loss

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LQI_RX	This field will contain the last received Link-Quality-Index measured by the ESL, indicating the connection strength with the base station. See LQI
LAST_POLL	This field will contain the UTC time of the last received poll for data. <Null> means unknown / never received. (This field is currently not updated on each poll to reduce the amount of SQL queries executed by the ESL server).
LAST_INFO	This field will contain the UTC time of the last reported status by the ESL. <Null> means unknown / never received.
LAST_IMAGE	This field will contain the UTC time of the last successful image update. <Null> means unknown or hasn't been updated.
BASE_STATION	If the ESL is/was connected to a base station, this field will contain the IP address of the last base station it was connected to. String format is xxx.xxx.xxx.xxx (i.e. 192.168.0.12). <Null> = unknown or never connected. Use the 'STATUS' field to verify if the ESL is currently connected or not.
SCAN_CHANNELS	This field contains an integer value of which each bit represents an RF-channel on which the ESL will or will not search for base stations (when not connected). Example: 101746688 would represent a binary value of '11000010001000100000000000'. Counting from right to left this means, channels 11, 15, 20, 25 and 26 will be searched. <Null> = unknown.
STATUS	This field contains an integer value representing the last reported status of the ESL. <NULL> = Unknown 0 = ASSOCIATED 1 = POLLING 2 = INFO RECEIVED 3 = DISASSOCIATED 4 = COMMAND COMPLETED 5 = COMMAND NOT_ACCEPTED / DISGARDED 6 = POLL TIMEOUT 7 = COMMAND_TIMEOUT 8 = ADDRESS CHANGED (factory status only) 9 = DEACTIVATED 10 = IMAGE_UPDATE_COMPLETED 11 = IMAGE_UPDATE_FAILED 12 = FIRMWARE_UPDATE_COMPLETED 13 = FIRMWARE_UPDATE_STARTED 14 = FIRMWARE_UPDATE_FAILED

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	15 = REACTIVATED
FIRMWARE_STATUS	This field contains an integer value representing the last reported status of the ESL. <NULL> = Unknown 0 = Idle 1 = Firmware update pending 2 = Firmware update queud 3 = <not used for firmware updates> 4 = Firmware update failed 5 = <not used for firmware updates> 6 = <not used for firmware updates> 7 = <not used for firmware updates> 8 = Firmware update succesfully completed
IMAGE_STATUS	This field contains an integer value representing the last reported image status of the ESL. <NULL> = Unknown 0 = Idle 1 = Image update pending 2 = Image update queued 3 = Image update queued and next already pending 4 = Image update failed 5 = Image update failed, waiting for retry 6 = Image update failed, busy retrying 7 = Image update failed, busy retrying, next pending 8 = Image updated succesfully 16 = Image error (image could not be opened, found or generated)
X, Y	If the ESL is linked, these fields contain an integer value of the X-, Y-offset of the generated image on the ESL. Generally, these values will be '0'. <Null> = Unknown or not linked
WIDTH, HEIGHT	If the ESL is linked, these fields contain an integer value of the width and height (in pixels) of the generated image on the ESL. Generally, these values will be 200 x 96 for the EE201. <Null> = Unknown or not linked
IMG_IX	This field will generally be '0'. Only if multiple products are shown on a single large ESL, then IMG_IX will be different for each image that is displayed on the ESL. <Null> = Unknown or not linked
IMG_FORMAT	If an e-paper ESL is linked, this field will generally be set to '1' indicating that the image is transmitted compressed to the ESL. If the data is sent uncompressed it would be '0'. Other

	values are reserved for TFT based ESLs (TIFF=2, JPG=3, GIF=4, FIRMARE=5). <Null> = Unknown or not linked
BOOT_COUNT	Shows how many times the firmware of the ESL was reset
TEMPERATURE	Shows the temperature range on which the ESL is supposed to run on (0=default; higher values are to compensate for low temperatures). Please note that low temperatures and values > 0 will increase power consumption!
PANID	PANID of the base station to which the ESL is/was associated.
LANID	LANID = 0000 means ESL will associate to all base stations. LANID <> 0000 means ESLs will only associate to base stations with the same LANID or with LANID 0000
MAC	MAC address of the requested ESL
CHANNEL	RF channel of the base station to which the ESL is/was associated (11…26)
BATTERY_VOLTAGE	Battery voltage indicator
IMAGE_ID_LOCAL	Image ID as reported by the ESL. 0=default image; 1=custom Image; <Null> = Unknown.
LED_OPTIONS	Reserved for LED status/options of ESLS with LEDs
NFC_OPTIONS	Reserved for NFC status/options of ESLS with NFC
TOTAL_STATUS	Reserved for overall status of the ESL (combination of connection-, image-, firmware- and battery-status)

Linking / Unlinking

ACTION	MAC	PARAM1 (default; min; max)
Link		
`POST http://localhost:8791/Links/{MAC}/{barcode or ID}`		
Unlink	MAC-Address (8)	Barcode/ID
`DELETE http://localhost:8791/Links/{MAC}`		
Get link(s) by MAC/ID	MAC-Address (8) or Barcode/ID	
`GET http://localhost:8791/Links/{MAC or ID}`		
Get all link(s)		
`GET http://localhost:8791/Links`		

Product table

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ACTION	Param	Body
Get Product	Barcode/ID or Search string	-
`GET http://localhost:8791/Products/{Barcode_or_ID}`		
Get Products	-	-
`GET http://localhost:8791/Products`		
Add / Replace product	-	Array of products (use same body formatting as 'Get product(s)' response
`POST http://localhost:8791/Products`		
Delete product	Barcode/ID	-
`DELETE http://localhost:8791/Products/{Barcode_or_ID}`		

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POST & DELETE requests for Base stations

The following list of POST and DELETE commands are currently supported to initiate an action on a base station.

ACTION	MAC	PARAM1
REACTIVATE_START	MAC-Address (12)	Timeout in sec (min 30, max 900)
POST http://localhost:8791/EBS/{MAC}/REACTIVATE_START/{Time}		
REACTIVATE_STOP	MAC-Address (12)	
POST http://localhost:8791/EBS/{MAC}/REACTIVATE_STOP		
BALANCE_ESLS		(Use preferably once a day)
POST http://localhost:8791/BALANCE ESLS		
REFRESH_ESLS		(Warning: Refreshing effects battery life!)
POST http://localhost:8791/REFRESH ESLS		
RESET	MAC-Address (12)	
POST http://localhost:8791/EBS/{MAC}/RESET		
ADD	MAC-Address (12)	IP / Port number / Variant
POST http://localhost:8791/EBS/{MAC}/ADD/{IP}/{Port}/{Variant} Example: http://localhost:8791/EBS/00126AF5FFE7/ADD/192.168.0.63/1002/EBS40		
REMOVE		
DELETE http://localhost:8791/EBS/{MAC}		
FIRMWARE_UPDATE		Filename
POST http://localhost:8791/EBS/{MAC}/FIRMWARE UPDATE/{filename}		

Supported Base station settings

The following POST-commands are currently supported to change Base station settings.

ACTION	MAC	PARAM1
CHANNEL	MAC-Address (12)	RF-Channel (int) (**default 11**, min 11, max 26)
POST http://localhost:8791/EBS/{MAC}/CHANNEL/{value}		
PANID	MAC-Address (12)	PAN-ID (4) (default: last 4 digits of MAC)
POST http://localhost:8791/EBS/{MAC}/PANID/{value}		
LANID	MAC-Address (12)	LAN-ID (4) (**default 0000**,min 0000,max FFFE)
POST http://localhost:8791/EBS/{MAC}/LANID/{value}		
LOCAL_NAME	MAC-Address (12)	Local name (default: EBS40_xxxx, where 'xxxx' are the last 4 digits of MAC)
POST http://localhost:8791/EBS/{MAC}/LOCAL NAME/{value}		

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The following GET-requests are currently supported to get the status and configurations of a base station.

ACTION	MAC	PARAM1 (default; min; max)
GET http://localhost:8791/EBS		
	MAC-Address (8)	
GET http://localhost:8791/EBS/{MAC}		
	MAC-Address (8)	Name of the setting/variable
GET http://localhost:8791/EBS/{MAC}/{Variable}		
DISCOVER		
GET http://localhost:8791/EBS/DISCOVER		

Variable	Description
IP	Current IP address of the base station
PORT	Current IP port number of the base station
MODEL	Current hardware model of the base station (EBS30/EBS31/EBS40)
LOCAL_NAME	Current local name f the base station
PANID	Current PAN-Id on which this base station operates
CHANNEL	Current RF-channel on which this base station operates
VERSION	Firmware version of the base station
STATUS	Current connection status (Connected or Disconnected)
NR_OF_ESL	Current number of associated ESLs to this base station
LANID	LANID = 0000 (default) means all ESL will associate with this base station. LANID <> 0000 means only ESLs with the same LANID or with LANID=0 will associate with this base station

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Appendix L: Version history

V1.0.50.7	- Fixed filtering by ESL variant - Added 'save as' and 'delete' option to template editor - Template editor: Changed text-buttons to icons - Added validation checks to exporting templates - Fixed Windows 10 issues with MySQL - Added support of reactivate by address range to ESL server - Improved importing of setting files (at startup)	Feb 12, 2016
V1.0.51.0	- Updated firmware for all Base stations (IBMV0023 / IBUV0055) - Adds support of reactivate by range - Updated firmware for all ESL variants (IBxV0074 / IRV0075) - Adds support of activate by range - Black / white / red display support - Added support for more ESL display formats to web application - Removed use of CSV-Parser by default (discount percentage is no longer calculated by default) - Restyled image templates of all ESL variants - Fixed issue with links not being processed when they were only pasted - Fixed issue with processing links that are identical - Fixed issue with template editor causing selected drawing object to duplicate after saving - Improvements to automatic firmware updating of ESLs - Sorted list of base stations in discover box for easier selection - Restored auto complete when filtering on ESL properties	Apr 1, 2016
V1.0.52.1	- Added user interface for template selection - Removed XML-editor for template editing and template selection - Added GUI for editing conditions and extended matching conditions - Simplified linking of ESLs to products in ESL server - Added possibility to link using USB-HID barcode scanner - Added support of arrow-keys to position object in templates - Fixed issue with automatically updating dbconfig.php from the web app - Base station exceptions are now logged with mac address - Reduced logged base station connection errors in case connection is lost - Added SQL action: REFRESH_ESLS - Added support for scheduling daily events - Added preview mode in template editor - Web applications update	May 11, 2016
V1.0.52.2	- Template Editor: Simplified user interface	May 23, 2016
V1.0.52.4	- Fixed issue with showing incorrect ESL settings during firmware update - Fixed issue of showing disassociated ESLs in the list of active ESLs - Improved firmware updating of an EBS30/EBS40 - Resolved Image-ID resetting to 1 after relinking ESLs to another product (CSV-only) - Find ESLs linked to unknown product with filter 'pending/error ESLs' - Mark ID-column of ESLs linked to unknown product as red and show status: 'Product not found'	June 8, 2016
V1.0.53.2	- Fixed issues with ESLs not showing latest image (under poor reception circumstances) - Reactivation: automatically fill in the known mac address range when selecting the variant - Disabled firmware updating on different subnets with firmware version IBMV0017 and lower - Fixed exception on adding links without variant selected - Added 'Unlink'-button when editing existing links in Link-dialog - Web application: Fixed issue with automatically detecting the hardware variant - Added protection against downgrading of ESLs to firmware with hardware incompatibilities - Added preliminary EE750R support - Fixed not processing product database CSV-files without empty first column	Aug 4, 2016
V1.0.54.4	- Added support for showing multiple products on a single ESL - Added support of regular expressions in templates using the comment field (start with '@' followed by the regex match string (optional: following by a '@' and the replacement string) - Split GUI from background process, allowing to run the ESL server without GUI (using –-console or –-service argument) - Changed logging method of CSV to SQLite - Added trouble shooting section to base station firmware updating - Resolved issues with running as service on Windows 10 - Improved error handling when the database connection fails at start-up	Nov 2, 2016
V1.0.55.0	- Fixed parsing of csv files with decimals into SQL - Fixed rare crash with crosshair cursor of template editor - Fixed issues with template condition 'x=y'	Nov 17, 2016

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	- Use '%umac%' to add shorter mac address in template - Fixed rare crash on closing discover box - Oracle: Resolved issues with auto incrementing ID and 'Transaction' property - Improved resizing of ESL server on small display monitors - Fixed sending too many reset-to-default-image commands on unlinking - Fixed issue with parsing product changes from product staging table - Automatically truncate CSV fields that are longer than the SQL column - Fixed linking/unlinking issues in ESLs-tab - Added tooltip to sample text boxes with column names - Web application: Removed case-sensitivity on MAC addresses - Web application: Fixed incorrect linking of EE150R as EE150 - Updated EE150R firmware to IRTV0081 (requires EBS firmware IBMV0027 / IBUV0059 or higher)	
V1.0.55.2	- Fixed double transmission of images (introduced in 1.0.55.0) - Fixed GDI object leak in crosshair of template editor - Fixed issues with *-wildcard characters in conditions	Dec 1, 2016
V1.0.55.7	- Huge performance update on processing of staging tables and importing CSV files into SQL - Web application: Added warnings when ESL or ESL server is offline - Web application: Allow scanning of ESL and product barcode in any sequence during linking - Fixed uncaught exception on 32-bit systems with template editor - Improved MAC address validation on linking - Fixed double image update complete event after resending of missed frames - Fixed exception on product/linking table view during processing of CSV-files - Fixed issues with 64-bit Oracle versions (incl. action tables and table lists) - Added option to only load products in memory that are currently linked - Show 'VIEWS' in SQL table lists	Jan 18, 2017

V1.0.60.1	- Added support for PostgreSQL, SQLite, ODBC and DB2 databases
	- Added SQL setting: field separator (for CSV-input files)
	- Web application:
	  ▪ Merged WebApp-Linking into WebApp-Full; Restyled user interface
	  ▪ Added support for CSV, all SQL database formats and ODBC
	  ▪ Added reliable ESL server status to overview
	  ▪ Added image preview from images stored in database
	- Added scroll bars to main windows if too small
	- Added example queries for product tables for SQL variants to Example-folder
	- Fixed issue of V1.0.55.7 causing products changes not to be processed to newly linked ESLs
	- Updated barcode terminal applications to version 3693.6
		Mar 30, 2017

V1.0.61.2	- Added preliminary ET350 support - Fixed rare racing conditions - Improved switching between configurations using the 'import'-option - Added option to reduce bandwidth when using an external database - Added 'cleanup' option to delete and recreate all logging tables - Changed 'variant' column in labels status to readable text - PostgreSQL: fixed missing DLL in installer - Web application: Fixed linking of ESLs with EAN codes starting with a zero - Fixed rare issue causing dithered images not to be displayed	June 21, 2017
V1.0.62.0	- Added ET350 support, including full color support in template editor - Drag & drop of images into templates - Support of jpg-images, animated gifs and slideshow support - Added fit, stretch and crop scaling option for images - Firmware updating of TBS350 and ET350 - Added firmware into 'Firmware' folder - Web application: Added ET350 support - Added configurable opacity for graphical objects - Lowered required .NET frameworks version to .NET frameworks 2.0 - Relaxed color threshold for red for black/white/red ESLs	July 14, 2017
V1.0.62.2	- Resolved image update issues with the ET350 - Fixed issue with importing CSV link-files when using SQL - Improved handling of dynamically changing IP-addresses - Resolved MS-SQL issue with reprocessing of all links - Improved importing of config-files: list of base stations can now be imported - Fixed rare exception in discover box - Resolved issue with prices not updating when multiple ESLs are newly linked to the same product	Aug 2, 2017
V1.0.63.1	- Added 'Template Designer' shortcut to start menu - Added option to run multiple instances of ESL server by using --config="<config file>" argument - Fixed incrementing image ID by 2 (instead of 1) on every product update	Sept 7, 2017
V1.0.63.2	- Added PER radio test mode for updated EU standard EN300328	Oct 12, 2017

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V1.0.64.0	- Added web service with REST API (requires .NET frameworks 3.5 or higher) - Added DELETE option to both unlink and remove ESL from status table - Extended 'Clean Up' with option to unlink inactive ESLs from the system	Dec 4, 2017
V1.0.64.3	- Added possibility to add ESL properties to a template (i.e. showing the battery status)	Dec 18, 2017
V1.0.64.6	- Fixed issue with PAN-ID column of label status table - Resolved issue with base station repeatedly going offline - Resolved issue with passing event arguments to a web service - Fixed EBS firmware update error: Remote host forcibly closed the remote connection	Feb 19, 2018
V1.0.65.3	- Fixed automatic firmware update EE292; Added support for EE152 - Fixed issue with layers on ET350/ET1002 templates - Try to create a database on importing config-file - Show ESL server info on http://localhost:8791 to indicate ESL Server is online - Improved ESL problem overview - Improved linking (show list of products when product input results in multiple matches) - Added URL registration of web service / REST API to installer - Added XAMPP to ESL Server installer with (installs XAMPP with ESL Server specific settings) - Changed default port of web application to 8015 (was port 80) - Fixed issue of 2 instances of the ESL Server running simultaneously when service was enabled	May 18, 2018
V1.0.65.7	- Add support of EE202R (EE210R in an EE202 housing) - Fixed issue on calling web requests on scheduled events - Allow selecting of product columns in external triggers - Disabled deactivation of non-battery powered ESLs - Fixed database clean-up when using MS-SQL - Web-app: Fixed double 'linking successful' message - Web-app: Fixed multiple-connection errors message with ODBC connections	July 20, 2018
V1.0.65.11	- Fixed rare exceptions on (dis)associating ESLs - Fixed issue with finding base stations when having multiple network adapters - Allowed short mac addresses in link file - Changed exception level of XML-objects on web requests down to warning - Add possibility to call scheduled events every minute - Resolved rare exception in template editor	Oct 10, 2018
V1.0.67.12	- Upgrade to .Net Framework 4 - Automatically create folders when they don't exist - Resolved image update issues with black/white/red ESLs - Simplified filtering and sorting of ESL List - Added support of ESL variants with black/white/yellow - Added possibility to copy information from the ESLs-tab using a right click - Corrected List of discovered Base stations in REST-API - Added EE292R / EE153R / EE213R support	Dec 14, 2018
V1.0.68.1	- Extended REST-API with XML/JSON product table support - Resolved issue with incorrect pending/total counters	Feby 6, 2019
V1.0.68.6	- Upgrade to .Net Framework 4.6 - Resolved image update issues with black/white/red ESLs - Simplified settings-tab (moved Event-handler to settings-tab) - Created Log-tab for showing log files - Switched from displaying 16-digit MAC addresses to 8-digit MAC-addresses - Fixed MS-SQL issue in Web application - Fixed issue with event handler not updating after changing database settings - Fixed switching back to normal image directly after action 'show default image' - Fixed automatic firmware updating if input folder wasn't '/Input' - Renamed EE292 / EE152 to PE292 / PE152 (with backward compatibility) - Added undo and redo button on template editor	Mar 22, 2019
V1.0.68.7	- Fixed image displaying issue with EE15x/EE21x on images with many details - Fixed issue with linking due to incorrect column width of link staging table	Mar 28, 2019
V1.0.68.8	- Simplified XML format of external content management solution	Apr 3, 2019
V1.0.68.9	- Fixed rotated text with 270 degrees - Fixed linking issues (with layering enabled) - Fixed issue with condition build-box	Apr 5, 2019
V1.0.69.0	- Fixed issue with changing the template selection sequence	Apr 11, 2019
V1.0.69.3	- Fixed rare issue with missing apply button in settings-tab - Updated firmware files for linking with batch terminals (removed mandatory address check) - Added preliminary export-settings option - Moved import-settings option to settings-tab	Apr 25, 2019

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	- Fixed issue with ESL-tab actions with offline ESLs (i.e. linking, unlinking) - Fixed resize issue of ESL-tab on certain platforms - Fixed issue with creating multiple users	
V1.0.69.4	- Fixed upgrade issue: Losing links when upgrade from 1.0.68.4 or lower (SQL only) - Fixed issue with editing non-ascii product descriptions in Data-tab (MS-SQL only) - Fixed issue with cancelling ESL actions: Move to base station and firmware update	Apr 29, 2019
V1.0.69.7	- Fixed issue with storing settings and changing languages - MS-SQL: Fixed UTF-8 encoding issues - Fixed issue with converting links from long to short MAC address - SQL: Allow changing of barcodes when it isn't primary key	May 05, 2019
V1.0.70.0	- Finalized transition from long to short MAC addresses (incl. web application) - Fixed issue with applying settings when ESL service was installed - MySQL: Changed encoding of LabelStatus-Table to UTF-8	May 20, 2019
V1.0.70.5	- SQL: Fixed issue with option 'load only linked products' - Fixed issue with sorting conditional templates - Added MS-SQL to ESL web application without use of ODBC - Preliminary support of ET-1100 in mainstream version - Fixed incorrect displayed value of 'display orientation'	May 28, 2019
V1.0.70.9	- ET350: Fixed image update issues - ET1100 / ET1002: General improvements (preliminary)	June 12, 2019
V1.0.70.12	- Added PE-292B support (PE-292 with chargeable battery) - Fixed issue with PE-292/PE-152 event handler - Added possibility to move base station to (connected but) non-discoverable base stations - Added support for automatically parsing of .txt files - Fixed SFTP error when uploading to an ET-1002 - SQL: Fixed issues when the column sequence of staging tables did not match product table - Added firmware Version 0134 for all Black/white/red ESLs - PE-Range: Added power saving options (requires firmware V0136 or higher)	July 30, 2019
V1.0.70.13	- Added REST-API call to get or modify a single field of a product - Fixed variant issue with PE292R - Fixed issue with tapping PE292 when base station is on different subnet - Fixed unnecessary refreshes of GUI on extern product changes	Aug 2, 2019
V1.0.71.1	- **Resolved Image update issues when Image ID > 127** - Resolved issues with LED behavior in templates and REST-API command - Fixed bug that prevented ESLs with image status errors to manually resend image - Fixed reload & search-button on logs-tab - Fixed rare reconnect failure on disconnected base station - Fixed issue with battery status unwantedly showing empty battery on 2.83V - ESL-tab now shows local name of base station instead of IP-address - MS-SQL: Fixed unlinking using web application - Fixed rare issue that could cause 2 ESL Server processes to be running	Oct 16, 2019
V1.0.71.3	- Example data no longer shows more columns than are available in the product database - Improved browse button of Image-objects in template designer - Added 50% zoom option in template editor for larger ESLs - Fixed running as service issues (cause by recent Windows 10 update) - PE-Range: Added RTTTL-sound format support to REST-API - Added LED option 'Controlled by API' to ignore LED-changes when template is sent without LEDs - ESL Server REST API can now change products of CSV database - Added address range for PE152/PE292 with FeLiCa/NFC-B support - PE-Range: Added REST-API commands for Sound and buzzer control	Jan 10, 2020
V1.0.71.4	- Certified installer (to resolve unknown publisher issues) - Resolved issues in 1.0.71.3 with user table and example text boxes	Jan 23, 2020
V1.0.72.0	- Resolved issue with template with LEDs after restart of ESL Server or resend image - Fixed address range PE-152 - Renamed REST-API LED colors and modes to shorter names for ease of use	Jan 30, 2020
V1.0.72.6	- Many minor improvements and bug fixes - Added layering support in combination with CSV-files - Improved ET1002/ET1100 support - Changed REST-API response format of POST/ESL/{MAC}/{property}/...' and 'GET /ESLS/{MAC}/{property}' - Updated firmware of EE153, EE202R, EE213R, EE293R, EE420R and EE750R to V0159 - Add Black/white/yellow display e-paper support - Resolved installer issues causing .dlls and .config files not to be updated	Apr 20, 2020
V1.0.72.8	- Fixed issue with unlinking in combination with CSV-files	Apr 20, 2020
V1.0.72.10	- Fixed REST-API call http://localhost:8791/Links - Added REST-API call for (un)linking and altering/reading product table	July 7, 2020
V1.0.73.0	- Added roaming feature for installations with non-stationary ESLs (requires firmware IxxxV0164 or higher and LANID to be set to non-zero on both ESL and Base stations)	Aug 4, 2020

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	- Updated firmware of EE750R to resolve display issues - Fixed base station REST-API endpoints	
V1.0.73.4	- Updated REST-API endpoints - Fixed rare issue with images not being sent (after status tables were missing or not available) - Added preliminary 13.3" ESL support (EE1330R) - Updated firmware of EE750R (resolve rare display driver issues)	Nov 20, 2020
V1.0.73.8	- Fixed rare issue with images not being displayed when sent 2 quickly updates in a row - Added FireBird SQL database support - Added Black/white/yellow ESL support	Jan 13, 2021
V1.0.74.3	- Fixed base station disconnecting issues (use IBUV0066a or higher) - Added support for EE750R with IRYX firmware variant - Improved parsing of SQL query files - Changed battery status values - Performance improvements on storing, generation and loading of images - Added processing state while image is being checked & displayed - Improved handling of image update errors - Add support of importing zip files containing configurations and/or templates	Aug 6, 2021
V1.0.74.5	- Fixed issue with ET350 image generation - Fixed firmware update issue with EE420R/PE152R/EE750R with new hardware - Fixed issue with ESL list not being requested from EBS at start-up	Sep 24, 2021
V1.0.74.7	- ET350/ET1002: Replaced use of WinSCP by platform independent option - Updated Web application with ESL actions: reset, resend, refresh, reassociate and bugfixes - Updated firmware for ESLs (V0178) to resolve roaming and 'show default image' issues - Fixed ESL counter issues on base station-tab - Add support of moving ESLs to EBS-50's - Store mac address of base station instead of IP in labelstatus	Dec 10, 2021
V1.0.75.0	- Fixed association issues after reactivation - Added support of EE293R_NFC	Jan 20, 2022
V1.0.75.7	- Allow adding of EBS-50 ('allow remote connections' must be enabled on EBS-50) - Made Esl Server application discoverable in EBSFinder - Fixed issues with EBS disconnecting under heavy traffic and/or many pending updates - Fixed Template editor bug with adding of local images - Added PE293 support - Fixed issue with template designer layout - Resolved ESL firmware update issue - Fixed rare exceptions with sample data and product search dialog	May 10, 2022
V1.0.76.0	- Bug fix: Incorrect or no LQI values being displayed (introduced in 1.0.75.1)	Jun 21, 2022
V1.0.76.2	- Fixed issue with adding new base stations (introduced in 1.0.75.7) - Minor bug with multiple OR conditions in templates)	Jul 12, 2022
V1.0.76.10	- Added retransmission of Peripheral commands (LED, SOUND, NFC commands) - Added API GET endpoint to retrieve status of sound/led commands - Update GUI on queueing and completion of LED API commands - Fixed issues with connecting to EBS's on different subnets - Detect and autocorrect incorrect EBS variant on manual connections	Nov 11, 2022
V1.0.77.0	- Added cleanup (vacuum) on SQLite database (on restart)	Dec 6, 2022

V1.0.78.3	- Added EE261R (2.6") support; Added EE214R support; Fixed EE202R support
	- Resolved some Oracle issues (casting and user table)
	- Fixed issue with storing images as file and processing zip-files
	- Template editor:
	  o Replaced image rendering engine (same as EBS-50)
	  o Updated default templates
	  o Allow Select, move, copy cut, paste of multiple objects
	  o Automatic resizing of templates when changing variant/portrait mode
	  o Added variant selection on preview dialog by right-clicking
		Jun 20, 2023

V1.0.78.4	- Improved GUI on LED status information to show current LED state - Fixed issue with leds turning off even when API controlled LED option - Added support for adding a flash count to a LED object - Added EE241RY, EE261RY, EE293RY, EE420RY and EE750RY support	Dec 6, 2022

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