

IPTV MAG-200 High resolution device Operator Guide

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Definitions

Bootloader – Bootloader allows loading and starting the basic program.

Basic program – the complex of software and hardware, which allows rendering services to the user.

Bootstrap – Specially prepared image for the basic program upgrade. It consists of the Linux core and RAM root file system signed with a digital signature.

Core – Linux core.

Cyclic multicast group – multicast group with cyclic broadcast of data.

Bootloader of the device

The bootloader is used for loading and starting the basic program. The bootloader allows loading the basic program from the network and from nand-flash with further check of the loaded image integrity. The basic program can be loaded from the network using tftp protocol or from the multicast group. The loading stages are reflected on TV screen and on the front panel indicator. The bootloader menu can be used to change the loading mode, to set logo and operator key.

After the device is switched on the bootloader sets the following modes of video outputs:

- HDMI, Component (YPrPb), SCART – 576p;
- CVBS, S-Video – 576i

Some menu items set the variables of the bootloader. Sometimes there may arise the necessity to know the values of these variables. This can be achieved with the help of the utility [fw_printenv](#). For example, the command “**fw_printenv tvsystem**” shows the current value of the variable tvsystem.

Bootloader menu

To enter the bootloader menu press and keep the key “menu” on the remote control or the key “On/Off” on the front panel and switch on the device.

Navigation in the bootloader menu is ensured with remote control and front panel keys. The keys Up/Down allow moving between the menu items. The key “to the right” allows entering a menu item or changes the item value. The key “to the left” provides exit to the previous menu or confirms the performance of the operation (“OK”).

Menu description

TV System

It sets the mode of video outputs in the basic program. The basic program checks the value set in this item and correspondingly initializes the video output.

This menu item sets the variable “tvsystem”. The following values are possible:

- PAL;
- 576p-50;
- 720p-50;
- 1080i-50;
- NTSC;
- 576p-60;
- 720p-60;
- 1080i-60;

Graphic Res.

Sets the resolution of graphic window for the basic program. The basic program checks the value set in this item and sets the corresponding resolution for the graphic window of the supplement. If the value of the resolution specified exceeds the value of resolution of the video outputs, the most appropriate resolution shall be used. This item of the menu sets the variable “graphicsres”. The following values are possible:

- 720x576;
- 1280x720;
- 1920x1080;
- TV System Res..

If the value of «TV System Res.» is set, the resolution corresponding to the current mode of video outputs is used.

Component out

Sets the mode of the component video output in the basic program, The basic program checks the value set in this item and sets the mode of the component video output.

This menu item sets the variable “componentout”. The following values are possible:

- YPrPb;
- RGB.

Boot Mode

Sets the mode of the basic program loading. The following values are possible.

- DHCP;
- NAND.

Device Info

Information of the device. The same information of the device and current IP can be obtained by issuing the command “/usr/bin/info.sh”

Loader Info

Information on the bootloader version and date of creation. This information is sent by the bootloader on dhcp request.

Image Info

Information on the image stored in nand-flash. This information is set by standard bootstrap when upgrading the image.

Version

The image version on the device is a number. The version is set by the operator in the process of forming the image. Standard bootstrap checks the version number on the device and performs upgrade only if the image version number is higher than the one installed or if the versions of images are the same and the value of item ““Forced” is set to “Yes”.

In this way the protection against double upgrade and return to the previous version image is realized.

This menu item sets the variable “Image_Version”

Date

The date of the image creation.

This menu item sets the variable “Image_Date”

Description

Short description of the image. It is set by the operator when creating the image.

This menu item sets the variable “Image_Desc”

Forced

Possible values:

- Yes;
- No.

This menu item sets the variable “Ver_Forced”

Upgrade Tools

Use upgrade

If the value “Yes” is chosen, the second image of the bootloader is set and the digital signature is checked; the second image shall be automatically started when the device is switched on. If “No” is set, the manufacturer bootloader shall be started.

Possible values:

- Yes;
- No.

This menu item sets the variable “bootupgrade”.

Auto Upgrade

Starts the process of upgrading the second copy of the bootloader.

MC Upgrade

Starts the process of upgrading the basic program using fixed multicast addresses.

Set LOGO&KEY

Starts the process of setting and upgrading the logo and operator key.

Reset Op.KEY

Allows resetting the operator key. Generally accessible key stb_pub_sign.key. shall be used as the key after reset.

Def. Settings

Reset of all bootloader variables. All variables of the loader are set to the manufacturer values.

Exit & Save

Exit from the menu and save all changes made.

Exit & Discard

Exit from the menu without saving the changes.

Bootloader upgrade

The manufacturer installs the bootloader to the device but there is a possibility to install another copy of the bootloader prepared by the manufacturer. The second copy is stored in the section mtd2 nor- of the flash memory.

To install the second copy of the bootloader proceed as follows:

1. switch off the device;
2. press the key "menu" on the remote control;
3. switch on the device;
4. select the menu item "Upgrade Image"/"Auto Upgrade";
5. wait till the operation is successfully finished;
6. set the item "Use upgrade" to "Yes".

When performing item 4 the device forms a dhcp-request with the following parameters:

1. vendor_class_id - "TeleTecMAG200upgboot"
2. dhcp_client_id - "TeleTecMAG200-XX:XX:XX:XX:XX:XX", where XX:XX:XX:XX:XX:XX – MAC device address
3. The section vendor_spec contains the following options:
 - Number of the bootloader version: Venum – format line "XXX" with leading zeroes
 - Date and time: datetime - "__DATE__" - "__TIME__"

Indicate the location of the upgrading file in the answer. The dhcpd.conf: file contents:

```
class "TeleTec MAG200 Upgrade"
{
    match if (( option vendor-class-identifier="TeleTecMAG200upgboot"));
    filename "mag200/Sboot";
    next-server 192.168.1.1;
}
```

The line substring (option vendor-encapsulated-options,2,3) returns the version of the bootloader.

According to the protocol tftp the device loads the flash located on the route filename ("mag200/Sboot") from the server specified in the next-server (192.168.1.1) and performs upgrading.

If the option "Use upgrade" is set to "Yes", it shall contain the following items when entering the bootloader menu: "Upgrade Tools", "Def. Settings", "Exit & Save", "Exit & Discard"; they agree with the bootloader items. Additional item "Upgrade Menu", appears, which allows moving to the full menu of the bootloader

If the option "Use upgrade" is set to "No", the manufacturer bootloader shall be used.

Setting the operator key and logo

The device allows setting the logo in the process of loading. This logo appears after switching on the device and before the basic program is started. Information messages that reflect the process of the basic program loading are displayed on the background of the logo.

Logo preparation

A file in the format bmp 8Bit, 16Bit 565RGB or 24Bit 888RGB can be used as a logo.

The file can be compressed with the archiver gzip:

```
gzip -S .gz ./STB-bootlogo.bmp
```

The size of the file to be installed in the device should not exceed 48Kb.

Logo installation

When the menu item "Upgrade Image"/ "Set LOGO&KEY" is chosen the device shall form a dhcp-request with the following parameters:

1. vendor_class_id - "TeleTecMAG200upglogo"
2. dhcp_client_id - "TeleTecMAG200-XX:XX:XX:XX:XX:XX", where
XX:XX:XX:XX:XX:XX – MAC device address

Indicate the location of the upgrading file in the answer. The contents of the file dhcpd.conf:

```
class "MAG200_upglogo" {  
    match if (( option vendor-class-identifier="TeleTecMAG200upglogo"));  
    filename "mag200/ STB-bootlogo.bmp.gz";  
    next-server 192.168.1.2;
```

```
vendor-option-space TeleTec;  
option TeleTec.logo_x 0;  
option TeleTec.logo_y 0;  
option TeleTec.bg_color 0x00006498;  
option TeleTec.fg_color 0x00FFFFFF;  
  
option TeleTec.oppubfile "mag200/op_stb_pub_sign.key";  
}
```

According to the protocol tftp the device loads ("mag200/ STB-bootlogo.bmp.gz") from the server specified in the next-server located on the route filename, performs check, displays the logo on the screen and saves the logo.

Besides, it is possible to set the coordinates of the left upper corner of the logo. These are dhcp options: TeleTec.logo_x – x axial coordinate, TeleTec.logo_y – y axial coordinate. If these options are not specified or if they are reset, the picture shall be automatically centered.

The options dhcp TeleTec. bg_color and TeleTec.fg_color allow specifying correspondingly the colour of the background and the colour of the type in the format "XRGB" for displaying information messages in the process of loading.

If the process was successfully completed, the variables of the bootloader "logo_x", "logo_y", "bg_color", "fg_color" are set to the corresponding values and the variable "showlogo" is set to "yes".

This process also sets the signed and prepared operator key. If the dhcp answer has the option TeleTec.oppubfile set, the attempt to read from the server the indicated file according to the protocol tftp is performed, and in case of success the bootloader variable "oppubKEY" is assigned with the contents of the loaded file. Hereinafter it shall be used as the operator key.

Steps after switching on the device

When the system is started, the bootloader analyses the loading mode set. If the mode "NAND" is specified, the basic program is started from nand-flash, if "DHCP" is specified, the start is performed using dhcp protocol.

Basic program loading mode “NAND”

If the basic program loading mode is set to “NAND”, the bootloader attempts to load the Linux core. The Linux core must be stored in the section mtd4, where the file system jffs2 must be installed and it should be called ulmage. After the core is loaded, its digital signature is checked using the operator key installed. (The operator key must be installed earlier; otherwise the accessible key stb_pubbin.key is used. In the image prepared by the manufacturer the core is signed using this key). After checking the core is started; in this case the section mtd5, where the file system jffs2 is to be installed shall be specified as the root file system.

If an error occurs at any stage of loading, the device automatically transfers to loading the basic program in the “DHCP” mode.

“DHCP” mode of the basic program loading

The device sends dhcp- request with the following parameters:

1. vendor_class_id - " TeleTecMAG200boot "
2. dhcp_client_id - "TeleTecMAG200-XX:XX:XX:XX:XX:XX", where
XX:XX:XX:XX:XX:XX – MAC device address
3. The section vendor_spec contains the following options:
 - a. Bootloader version number: Vernum – a line in the format "XXX" with leading zeroes
 - b. Date and time: datetime - "__DATE__" - "__TIME__"

Having received the dhcp-answer the bootloader analyses the presence of options TeleTec.mcip and TeleTec.mcport. If they are present the bootloader connects to the multicast group specified by these parameters and accepts the image from this group. If these options are not specified the image is loaded according to the protocol tftp from the server next-server located on the route filename ("mag200/Bootstrap") .

Thereafter the digital signature of the loaded image is checked using the installed operator key. After the check the image is started specifying the nfs section situated at the address specified in the option “root-path” as the root file system (the IP of the server should be specified in the beginning of this parameter followed by a colon and the location of the catalogue to be assembled as the root of the file system). The bootstrap ignores the option “rootp-path”.

The contents of the file dhcpd.conf:

- To load Bootstrap from multicast group 224.10.0.50:9000:

```
class "MAG200_boot" {  
  match if (( option vendor-class-identifier="TeleTecMAG200boot"));  
  
  vendor-option-space TeleTec;  
  option TeleTec.mcip 224.10.0.50;  
  option TeleTec.mcport 9000;  
}
```
- To load bootstrap according to protocol tftp:

```
class "MAG200_boot" {  
  match if (( option vendor-class-identifier="TeleTecMAG200boot"));  
  filename "mag200/Bootstrap";  
  next-server 192.168.1.2;  
}
```
- To load the core according to protocol tftp with the root file system connected via nfs:

```
class "MAG200_boot" {  
  match if ((option vendor-class-identifier="TeleTecMAG200boot"));  
  filename "mag200/ulmage";  
  next-server 192.168.1.2;  
  option root-path "192.168.1.2:/srv/mag200/rootfs";  
}
```

The last variant is most often used by integrators for adjusting the program and by operators for checking the image before forming the image for flashing to the device.

File /etc/exports must contain the line:
/srv/mag200 *(rw,no_root_squash,sync)

The indication of the basic program loading state

After the switching on the device, the logo, if set, is displayed on the screen while the front panel indicator shows "200". Then the bootloader displays information messages on the loading stages on the TV screen and on the front panel indicator.

Basic program loading stages	Front panel	Messages on the TV screen
Ethernet cable not connected	ErIn	"No link detected!!!"
Dhcp request sent	dHCP	"DHCP"
Repeated dhcp request (together with the number of the attempt)	dHCP	"DHCP Retry#"
Dhcp request failed	Er10	"DHCP Error"
Loading the core from mtd4	nand	"Load from nand"
Error when loading the core from mtd4	Er20	"Error loading image from nand"
mtd4 contents not correct	Er20	"Active partition not valid"
Bootstrap from a multicast group	load	"Multicast load"
Bootstrap according to tftp protocol	tftp	"Tftp load"
Digital signature check	chec	"Checking image"
Wrong image format	Er30	"Wrong image"
Wrong digital signature	Er30	"Wrong digital signature"
Core/Bootstrap launch	GO__	"Loading ..."

Bootstrap

Bootstrap allows to the operator upgrading the basic program stored in the device and performing the necessary settings. Bootstrap accepts, checks and launches the image. This image may be presented by the bootstrap signed with operator key installed in the device or by the generally accessible key-(stb_pubbin.key).

Standard bootstrap¹ consists of the Linux core and the root file system RAM.

dhcp-client is launched after the bootstrap. The dhcp-requests of the client contain the option vendor-class-identifier set to the value "TeleTecMAG200boot". If the dhcp-answer contains parameter TeleTec.mcip_img and TeleTec.mcport_img, the attempts to load the image prepared by the client are performed from the multicast group TeleTec.mcip_img:TeleTec.mcport_img. The parameter TeleTec.ip_log:TeleTec.ip_port determine the addresses, to which bootstrap attempts to send the

¹ Bootstrap prepared by the manufacturer. Only the functions and capabilities of this bootstrap shall be reviewed further.

results of its work. This report can be obtained by issuing, for example the command: `nc -l ip_port` from the server with `c IP - TeleTec.ip_log`.

Bootstrap performs the check of the digital signature of image received using the operator key, if set, otherwise the check is performed with the generally accessible key.

Each image subject to upgrading is associated with the following parameters:

1. The date of creating the image by the operator. Bootstrap variable - "Image_Date";
2. The image version number. It is specified by the operator when creating the image. The bootstrap variable - "Image_Version";
3. Short description. The line is set by the operator. The bootstrap variable - "Image_Desc".

Then the version number of the image received is checked. If the image number is higher than the number of the image flashed, no upgrading takes place. If the numbers are equal, the refreshing takes place only provided the item "Image Info"/ "Forced" in the bootstrap menu has been set to "Yes". If the image number is higher, the image is upgraded.

After upgrade has succeeded the bootstrap variables "Image_Version", "Image_Date" and "Image_Desc", as well as the "NAND" mode are set and the device is re-started. The bootstrap variables "Image_Version", "Image_Date" and "Image_Desc" can be viewed in the bootstrap menu "Image Info" or with the utility `fw_printenv`.

The process of upgrade is accompanied with displaying corresponding messages on the TV screen.

The contents of the file `dhcpd.conf`:

```
class "MAG200_upgrade" {  
    match if (( option vendor-class-identifier="TeleTecMAG200upgrade"));  
  
        vendor-option-space TeleTec;  
        option TeleTec.mcip 224.10.0.50;  
        option TeleTec.mcport 9000;  
  
        option TeleTec.mcip_img 224.10.0.51;  
        option TeleTec.mcport_img 9001;
```

```
option TeleTec.ip_log    192.168.1.2;
option TeleTec.port_log  10000;
}
```

The stages of upgrading the basic program on the device:

- Starting the device in the “DHCP” mode;
- Bootstrap loading from a multicast group or by ftp;
- Digital signature check;
- Bootstrap start;
- Receiving the image from a multicast group for refreshing;
- Checking the digital signature of the image received;
- Checking the image version number for upgrading;
- Upgrading sections on the device;
- Saving bootstrap variables;

Configuration and organization of the upgrading process using cyclic multicast group

To configure the system of upgrading images on the device using a cyclic multicast group perform the following steps:

- Adjust DHCP-server;
- Adjust the utility [mcsend](#) for cyclic broadcasting bootstrap and the image to upgrade to multicast group;
- Prepare images for broadcasting;
- Start the utility [mcsend](#)

The files Bootstrap and imageupgrade are broadcast for upgrading the program on the device. The file imageupgrade is a container handled by the Bootstrap, which contains the signed images of the sections mtd4 and mtd5.

Preparation of images for broadcasting

Before preparing the images set the operator key prepared by the operator or the default operator key. To use the default key perform the following commands:

```
gpg --import stb_secbin.key  
export MAG200_OP_KEY=STB_PUBLIC
```

The program contains the following images prepared for operation with default operator key:

File name	Description
Bootstrap	Bootstrap
ulmage	The core signed and prepared for start by the bootstrap. It is used for forming the image for upgrade, when working with nfs
ulmzlib_null.img	The section mtd4 image – is a file system jffs2 with ulmage
ulmzlib.img	ulmzlib.img signed image ulmzlib_null.img for including to upgradeimage.

If the operator key is used it is possible to use the files included in the software, if the key differs from the default key, the above mentioned files must be formed again.

Bootstrap preparing

For preparing Bootstrap use the file `./images/Bootstrap.clean`. Perform the command:

```
./bootstrap_sign.sh
```

It shall result in forming the Bootstrap prepared for starting on the device with the operator key as specified in the `USER_ID` installed.

Preparing ulmage, ulmzlib_null.img, ulmzlib.img

For preparing ulmage, ulmzlib_null.img, ulmzlib.img use the file `./images/vmlinux.bin`. Perform the command:

```
./kernel_sign.sh
```

Preparing imageupgrade

Preliminarily prepare the image of the device root file system and the file `ulmzlib.img`. It is recommended to check the root file system of the device in advance using `nfs` and `ulmage core`. Following this the operator possessing the right of access to the root shall start the file `img_make.sh`. For example:

```
./img_make.sh 5 "Test" ../rootfs
```

where:

- **5** – the image version number, which must be a number. After successful upgrade with standard Bootstrap the Bootstrap variable `"Image_Version"` takes this value;
- **"Test"**- short description. After successful upgrade with standard Bootstrap the Bootstrap variable `"Image_Desc"` takes this value;
- **../rootfs** – place of location of the device root file system catalog. The supplier provides an example of the root file system. The operator and integrator can, depending on their needs, enter the required amendments. For example, concerning the extension of the utilities set or additional commands and realize new algorithms for interaction with the device based thereon.

Adjustment of DHCP server

When the device is operation according to `dhcp` protocol, it fills the information element `vendor-class-identifier`. The analyses of the protocol allows determining some parameters and settings of the device, they are transferred in the answer of `dhcp-server` and affect the variants of loading and operation of the device.

The example of [dhcpd](#) server configuration is shown in the dhcpd.conf file. The options transferred by the information element vendor-specific are described in the section “Description of vendor specific options”.

The configuration of cyclic multi-cast server.

Circular multicast groups can be organized using the utility [mcsend](#) . The file [mcast.conf](#) contains the example of configuration, in which two multicast groups are organized. The first one 224.10.0.50: 9000 broadcasts boodstrap, the second one 224.10.0.51: 9001 broadcasts imageupdate.

The utility with prepared configuration file [mcast.conf](#) is started by the following command:

```
./mcsend -c ./mcast.conf
```

The description of the upgrade process using cyclic multicast groups

The process of updating the program in the device using cyclic multicast groups consists of the following stages:

- Start of the device in the “DHCP” mode. In doing so the device sends a dhcp-request from vendor-class-identifier="TeleTecMAG200boot" and receives the answer from dhcp-сервера from TeleTec.mcip and TeleTec.mcport;
- The device receives the image from the multicast group TeleTec.mcip:TeleTec.mcport (in this example 224.10.0.50: 9000);
- The correctness of the digital signature is checked using the operator key;
- The image received is started. In this example it is a boodstrap;
- Bootstrap is started and sends dhcp-request from vendor-class-identifier="TeleTecMAG200upgrade " and receives the answer from dhcp-server with TeleTec.mcip_img и TeleTec.mcport_img. set ;
- Bootstrap receives the image from multicast group TeleTec.mcip_img:TeleTec.mcport_img (in this example 224.10.0.51: 9001) – this is imageupdate;
- The correctness of the digital signature is checked using the operator key;
- The imageupdate version number is checked;
- Sections mtd4 and mtd5 are upgraded;
- The device is restarted in the "NAND" mode.

The description of the program upgrade process using fixed cyclic multicast groups.

To upgrade the program using “fixed” cyclic multicast groups it is necessary to organize cyclic multicast groups with the utility [mcsend](#) (for example). In this situation the device expects the group 224.50.0.50: 9000 to broadcast Bootstrap, while the second group 224.50.0.51: 9001 to broadcast imageupdate. The addresses of the groups are fixed for this procedure. The file [mcast_mcman.conf](#) contains the example of configuration which organizes these two multicast groups.

The process of upgrading the program in the device using “fixed” cyclic multicast groups consists of the following stages:

- Organize Bootstrap broadcasting at the address 224.50.0.50: 9000 and imageupdate broadcasting - at the address 224.50.0.51: 9001;
- Switch off the device;
- Press the key “menu” on the remote control;
- Switch on the device;
- Select the menu item “Upgrade Image”/“MC Upgrade”;
- The device receives the image from multicast group 224.50.0.50: 9000;
- For checking the correctness of digital signature use operator key;
 - Start the image received. In this example this image is presented by Bootstrap;
 - Bootstrap starts and receives the image from multicast groups 224.50.0.51 – : 9001 – this is the file imageupdate;
- The correctness of the digital signature is checked using the operator key;
- Imageupdate version number is checked;
- Sections mtd4 and mtd5 are upgraded;
- The device is restarted in the “NAND” mode.

With this process the basic program on the device can be replaced without using the protocols dhcp and tftp, it will suffice to organize broadcasting the required files and initiate the replacement of the basic program.

Operation with keys

Protecting system prohibiting the start of any programs unauthorized by the operator is realized in the device. For this purpose the algorithm DSA (digital signature) with the key length equal to 2048 bits is used, as well as manufacturer keys, operator key and the key for controlling the device.

- **Manufacturer key**

This key is used for checking the digital signature of the operator key. The secret part of this key is kept by the manufacturer.

- **Operator key**

This key is owned by the operator. The secret part of this key is preserved by the operator and used for signing the program started by the Bootstrap. This can be the core of bootstrap.

- This key is also used for signing the image broadcast in a multicast group and it is used by bootstrap to update the file system located in the device. The public part of the key is installed in the device through the bootstrap menu or by assigning “oppubKEY” to the variable of the bootloader. The public part of the key must be signed using the manufacturer key. This digital signature is subject to checking before using the operator key.

- **Key for controlling the device**

This key is owned by the operator. The key is used for signing commands sent to the device. Operator must place the public part of this key in the device. Operator commands for controlling the device on the server are signed with the secret part of this key and are sent to the device. The digital signature is checked on the device using the public part of the key. If the digital signature is correct, the command shall be performed. Other variants of using this key are available on the discretion of the operator. This key is not used in the process of loading the basic program. Utilities [dsign](#), [mcsend](#) and [mcrec](#), are supplied with the device basic program and allow realizing this algorithm and adapt other algorithms if necessary.

Operator key preparation

In the process of the operator key preparation proceed as follows:

1. Create the key

Start: **gpg --gen-key**

Select:

(5) RSA (sign only)

What keysize do you want? (2048) **2048**

Key is valid for? (0) **0**

Is this correct? (y/N) **y**

Real name:

Email address:

Enter passphrase:

2. Export of the key to the file:

gpg -o oppubbin.KEY --export "key ID "

after performing this command the public part of the key shall be contained in the file oppubbin.KEY ;

3. Send the file oppubbin.KEY to the manufacturer for creating a digital signature of this key with the use of the manufacturer key .
4. Install the resulting file in the device.

Default operator key

Default operator key is installed in the device with the following parameters:

- **USER_ID** - STB_PUBLIC;
- **Key fingerprint** - 2CE3 2C86 F4D4 D561 E676 B77B 8D87 EE65 6BEE D1ED;
- **passphrase** - absent.

The file stb_secbin.key contains the secret and public parts of this key. The file stb_pub_sign.key contains the public part of the key signed with manufacturer key and prepared for the installment to the device. The files stb_secbin.key and stb_pub_sign.key are usually supplied as the part of the program. If the operator key is not installed in the device or if it was reset the above-mentioned key is used as the operator key. We recommend to use this key for adjusting and checking the system workability. This key is used in the images supplied by the manufacturer. In the cases when operator uses his own key he must reassemble these images using his operator key for starting them in the device.

Notes concerning gpg program operation

The program `gpg`¹ is used for working with keys and creating the digital signature of images.

To transfer the key from one device to another you may use the following commands:

`gpg -o opsecbin.KEY --export-secret-keys "key ID "`

for preserving the information of the key in the file and

`gpg --import opsecbin.KEY`

for adding this key to `gpg` and

`gpg --list-keys`

for viewing currently available keys.

The utilities creating the image for upgrade and signing the core and bootstrap use the operator key according to "key ID ".

¹ `gpg` version 1.4.7 is used

Device control variants

The device offers the possibility to the operator to realize various algorithms of the device control. Among them: sending commands to the device via a multicast group, sending commands via JavaScript API. Because the system is open there is a possibility of adapting various own control and monitoring systems.

Sending and handling operator command using a multicast group.

The device program contains the utilities [dsign](#), [mcsend](#) и [mcrec](#) allowing the realization of the algorithm for sending and receiving commands from the operator to the device using a multicast group.

The whole process consists of the following stages:

1. Creation/preparation of the operator commands file;
2. Creation of digital signature using the operator key with the utility [gpg](#);
3. Transfer of the signed file containing operator commands via a multicast group;
4. Receiving data on the device from the multicast group;
5. Checking digital signature of the data received in the file with the utility [dsign](#) ;
6. `/usr/bin/cmd_parse.sh` start for each operator command with the name of the command specified by the operator assigned thereto as the first parameter; the second parameter contains the name of the file, in which the “command parameters” are stored.

Let us consider the variant of sending the command for restarting the device. It is performed using the file `reboot.sh`. It forms a temporary file with the command on restart and sends the file name as the parameter to `cmd_send.sh`. This command creates the digital signature and sends the resulting file to the multicast group `IP_CMD:PORT_CMD (224.10.0.52:9002)` with the utility [mcsend](#). If the parameters `TeleTec.mcip_mng`, `TeleTec.mcport_mng` in `dhcp-answer` are specified on the device, the operator commands are expected from this multicast group. The data received are stored in then temporary file, the signature is checked and `cmd_parse.sh` is called. The `cmd_parse.sh` determines that the first parameter has the value `Reboot` and `reboot` is performed, which results in restarting the device.

Adding own commands by operator.

Based on the above the addition of the operator command `TestComand` assumes the creation of the file on the server `testcomand.sh` (similar to `reboot.sh`):

```
cmd=./tmpcmd
```

```
rm -f $cmd
echo " TestComand ">$cmd
echo "##### END COMMAND #####">>$cmd
./cmd_send.sh $cmd
rm -f $cmd
```

and the addition of this command analysis in the file cmd_parse.sh in the device:

```
TestComand)
echo "steps for receiving TestComand"
;;
```

Format of the file containing operator commands

The operator forms the file containing sequentially listed commands to be performed on the device.

The file has the following format:

```
COMMAND (command name)
Command parameters (text).
##### END COMMAND #####
```

The file for the command Reboot:can serve as an example

```
Reboot
##### END COMMAND #####
```

The configuration of the transfer and handling of operator commands subsystem.

The value of "key ID" of the operator must be set in the variable MAG200_OP_KEY on the server.

IP address and the multicast group port for transferring commands must be set in the variables IP_CMD and PORT_CMD in the file cmd_send.sh

Set parameters TeleTec.mcip_mng, TeleTec.mcport_mng in IP-address and multicast group port in dhcpd. conf.

Operator commands

The following commands are supplied in the device program:

File nameИмя файла	Description
reboot.sh	Device restart
Rebootdhcp.sh	Device restart with further start in the "DHCP" mode

Control from the browser

The function `stb.E xecAction ("parameter EA")` can be called from the browser using JavaScript API. This results in starting the file `/home/default/action.sh` with the parameter "parameters EA".

Operator may add his processing to the file `/home/default/action.sh` thus extending the set of commands.

Utilities description

Utility fw_printenv

The utility allows learning the value of the bootstrap variable. It can be used by integrators and operators for creating various algorithms of the basic program operation.

Use:

fw_printenv 'variable name'

As the result, if such variable exists, this variable and its value can be derived.

Utility fw_setenv

The utility allows establishing the value of the bootloader variable. It can be used by integrators and operators for building various algorithms of the main program operation.

Use:

fw_setenv var1 1 "|" var2 2

The line "|" is used as the partition and allows establishing the value of several bootloader variables and avoiding a re-call of this utility. As the result the variable var1 shall set the value 1, while the variable var2 shall set the value 2.

If it is necessary to remove the variable omitting its value shall suffice. For example, for deleting the variable from the bootloader with the name var3: "**fw_setenv var3**".

Utility dsign

The utility dsign is designed for performing auxiliary works with the keys. The file activated in the operation is used as the input parameters. The operation for checking digital signature is most typical. For example:

./dsign --signfile ./test_img.sign --pubkey ./stb_secbin.key ./test_img

The example assumes that the file ./test_img.sign contains digital signature for the file test_img, while the file stb_secbin.key – contains the public part of the key in binary form.

The utility mcsend

The utility mcsend serves for broadcasting the set files to the set multicast address, each broadcast containing descriptive information, including identifier (serial number).

The following format is used:

mcsend [-ip addr:port] [-f filename] [-once] [-c config_file] [-s speed] [-sn SerialNumber] [-t time] [-i interface]

where

- filename – the name of the file to be broadcast;
- addr – the address to which the file is broadcast;
- port – the port to which the file is broadcast;
- -once – the file is broadcast only once;
- config_file – the name of the configuration file from which the settings for broadcast are received;
- speed – the rate of file broadcast (Byte per second);
- SerialNumber – serial number of the file (identifier);
- time – period of time after which the description of this broadcast must be sent (ms);
- interface – the name of the interface to which the file must be sent, for example eth0;

Default broadcast is started in the demo mode,

But if one of the options -f, -ip, -once is selected,

The control shall be returned to the utility only after the broadcast is over.

If the option -once is not specified the file shall be broadcast infinitely.

The utility can use the configuration file (option -c) for simultaneous broadcasting many files and for receiving the required parameter from the configuration. The configuration file must have the following structure:

```
[Server]
parameter_1=value1
parameter_2=value2
...
[section name_1]
```

```
parameter_1=value1
parameter_2=value2
...
[Section name_2]
parameter_1=value1
parameter_2=value2
...
[section name_3]
parameter_1=value1
parameter_2=value2
```

The section [Server] serves to set common parameter for all sections. The following sections describe the broadcast of a concrete file with its own parameters. The section [Server] may contain the following parameters:

- MulticastTTL,
- LogLevel,
- DataRate.

The whole list of allowed parameters is described below:

- MulticastIPAddress – the address to which the file is broadcast.
- MulticastUDPPort – the port to which the file is broadcast.
- FileName – name of the file to be broadcast.
- ImageName – similar to Filename.
- Description – the line of description to be contained in the description of broadcast
- SerialNumber – serial number (identifier) of concrete broadcast. If the file being broadcast is replaced it is recommended to change this value.
- PacketSize – the size of the packets being broadcast.
- CycleTime – the period of time after which it is necessary to send the description of the given broadcast (ms).
- MulticastTTL – the service life of TT packet.
- LogLevel – the level of log (does not influence anything at the moment).
- DataRate – the rate of data transfer (Byte per second).

Utility **mcrec**

The utility `mcrecv` serves to receive the file broadcast by the utility `mcsend`.

It has the following format:

`mcrecv -ip addr:port -f filename -m maxsize`

where

- `addr` – the address of the multicast group from which the file is received
- `port` – the port from which the file is received.
- `filename` – the name of the file to which the received file is saved.
- `maxsize` – the maximal size of the file allowed to be saved

After the operation is completed the utility sets the exit code to 0 if the file was received successfully or to 1 if an error occurred in the process of receiving. After the operation of this utility was completed additional processing of the file and restarting the utility for reception is possible. In this manner the processing of the operator commands sent through multicast groups is organized.

Utility “Front panel indicator control” (**setFpanel**)

The utility `setFpanel` serves to display text on 7-segment indicator on the front panel.

Format:

`setFpanel -s <line>`

in this situation the first 4 symbols from the line sent are displayed on the indicator, while the symbols not included in the list below or not converted into such symbols by changing the register are reflected as spaces:

'0', '1', '2', '3', '4', '5', '6', '7', '8', '9', '.', 'a', 'b', 'c', 'C', 'd', 'E', 'e', 'f', 'G', 'g', 'H', 'h', 'l', 'n', 'o', 'p', 'r', 's', 't', 'u', 'y', '_'.
'_'

The script `setFpanel.sh` is designed to control the display on the front panel. It can take the following parameters:

- `caption <line>` - display the first 4 symbols of the set line on the indicator similarly to the utility `setFpanel`;
- `led-on` – LED on;
- `led-off` – LED off;
- `colon-on` – colon on;

- colon-off – colon off.

Program lirc.

The program lirc is used for operation with remote control. The program has 3 operating modes:

1. Standard mode – when the key is pressed the pressings are repeated while the key is pressed;
2. After the key is pressed one event of pressing is sent and after the key is released the event of releasing the key is sent in the form <name_key>_UP;
3. When the key is pressed repeated pressings are received and when the key is released the event of the key releasing is sent in the form <name_key>_UP;

Each key is considered separately configured.

The configuration is performed via the file etc/lirc/lircd.conf

To configure mode 2 add the following after the key description (in ten same line):

```
" #BUTTON_UP mode=once"
```

To configure mode 3 add the following after the key description (in the same line):

```
" #BUTTON_UP mode=all"
```

If the key is not configured for mode 2 or mode 3, it operates in standard mode 1.

For example:

```
begin codes
.....
back      0x0000000000000138F
ch-      0x00000000000001B91 #BUTTON_UP mode=all
ch+      0x000000000000013BC #BUTTON_UP mode=once
.....
end codes
```

In this example the key "back" operates in mode 1,

"ch-" – operates in mode 3 (repeated pressings of "ch-" are received and after release - "ch_UP"),

a"ch+" – operates in mode 2 (one pressing of "ch+" is received and after release - "ch_UP").

Otherwise lirc operates as a standard program lirc, described at the address <http://lirc.org/>.

Processing the keys located on the front panel

To receive the pressings of front panel keys start the utility `fp_xevent` for Firefox using the configuration file `/etc/lirc/lircrc`, or `fp_qevent` for WebKit, which uses the configuration file `/etc/lirc/lircrc.wk`. Starting parameters and operating algorithm of these utilities are the same.

This utility has option `-t`, followed time in ms.

Two operating modes are available for this utilities:

1. Each pressing on the key is translated into the pressing a key on the keyboard corresponding to the keys:
 - `fp_power`
 - `fp_vol-`
 - `fp_vol+`
 - `fp_ch-`
 - `fp_ch+`

while releasing the key is translated into pressing the key on the keyboard corresponding to the keys:

- `fp_power_UP`
- `fp_vol-_UP`
- `fp_vol+_UP`
- `fp_ch-_UP`
- `fp_ch+_UP`

This mode is activated if the option `-t` is not set.

In this mode “short” and “long” pressings on the keys are distinguished, which allows assigning two functions for each key. The pressings after which the key is released during the period less than the time set by option `-t` are considered short, and they are translated into pressing the keyboard keys corresponding to the keys:

- `fp_power`
- `fp_vol-`

- fp_vol+
- fp_ch-
- fp_ch+

If the key is not released during the period of time set by option-t, the pressing is considered long and after the expiry of this period it is translated into pressing the keys on the keyboard corresponding to the keys:

- fp_long_power
- fp_long_vol-
- fp_long_vol+
- fp_long_ch-
- fp_long_ch+

Standard program is adjusted to use the second mode with the time period 500ms, “short” pressing on the key vol- is the movement to the left, “long” pressing - “Exit”, “short” pressing on the key vol+ is the movement to the right, “long” pressing — “OK”. Example of configuration file is shown in the supplement [Example of configuration file for setting front panel keys.](#)

Simultaneously with sending a keyboard key the LED on the front panel blinks.

Device restart with changing the loading mode

The device can be restarted with changing the loading mode after performing:

rebootmng.sh dhcp

to restart and set the regime of starting “DHCP”

rebootmng.sh flash

to restart and set the regime of starting “NAND”.

Supplements

Location of sections in nor-flash and nand-flash memory.

	Section	Designation	Size	Purpose
NOR	mtd0	BootLoader	256Kb	Boot loader
NOR	mtd1	Upgrade Boot	256Kb	Second copy of boot loader
NOR	mtd2	User's FS		Available to the user
NOR	mtd3	BootLoader Enviroment	64Kb	Boot loader data
NAND	mtd4	NAND FS 0	4Mb	File system jffs2 with Linux core. Boot loader extracts the file ulmage and starts it after checking.
NAND	mtd5	NAND FS 1	124Mb	The section of file system jffs2, assembled as a root system when starting in the mode "NAND".

Back panel connectors

The table of video outputs supported by the following modes:

	PAL (576i)	NTSC (480i)	576p-50/60	720p-50/60	1080i- 50/60
CVBS/SCART	+	+			
S-Video	+	+			
Component out/SCART – YPrPb	+	+	+	+	+
Component out/SCART - RGB	+	+			
HDMI	+	+	+	+	+

The connector SCART receives duplicated CVBS and component signals. Component output can be adjusted to sent signal YPrPb or RGB. The RGB mode can be used for display only with standard resolution.

Description of vendor-specific options

Name	code	Type	Description	Used by
mcip	3	Ip-address	IP address of multicast group for receiving the core or bootstrap	Bootloader
mcport	4	integer 16	Port of multicas6t group for receiving ten core or bootstrap	Bootloader
oppubfile	9	Text	Contains the name of the file with the prepared operator key for the installation in the device	Bootstrap
mcip_img	10	ip-address	IP address of the multicast group for receiving imageupgrade.	Bootstrap
mcport_img	11	integer 16	Port of multicast group for receiving imageupgrade.	Bootstrap
mcip_mng	12	ip-address	IP address of multicast group for receiving commands.	Basic program
mcport_mng	13	integer 16	Port of multicast group for receiving commands.	Basic program
ip_log	14	ip-address	IP address of the server to which bootstrap can send reports.	Bootstrap
port_log	15	integer 16	The port on the server to which bootstrap can send reports.	Bootstrap
logo_x	16	integer 16	X axial coordinate of the logo left upper corner	Bootloader
logo_y	17	integer 16	Y axial coordinate of the logo left upper corner	Bootloader
bg_color	18	integer 32	Background colour in the format "XRGB" for displaying information messages during loading	Bootloader
fg_color	19	integer 32	Type colour in the format "XRGB" for displaying information messages during loading	Bootloader
VerNumber	20	Text	Bootloader version - 3 symbols with leading zeroes. Example of use: substring(option vendor-encapsulated-options,2,3)="002"	Dhcp-сервер
DateTime	21	Text	Date and time of bootloader creation.	Dhcp-сервер
portal_dhcp	22	Text	The portal for transfer if the variable "portal1" and "portal2" are not set, and the variable "use_portal_dhcp" is not set or has the value "true". If the variable "use_portal_dhcp" is set to "false", the value of this variable is used.	Dhcp-сервер

Example of the file `dhcpd.conf`

```
option domain-name-servers 192.168.1.1;
option routers 192.168.1.1;
max-lease-time 7200;
ddns-upgrade-style none;
ddns-upgrades off;
log-facility local7;
default-lease-time 600;
not authoritative;
allow booting;
```

```
#####
# Option for TeleTecMAG
#####
```

```
option space TeleTec;
option TeleTec.mcip    code 3 = ip-address;
option TeleTec.mcport  code 4 = integer 16;
```

```
option TeleTec.oppubfile  code 9 = text;
```

```
option TeleTec.mcip_img  code 10 = ip-address;
option TeleTec.mcport_img code 11 = integer 16;
```

```
option TeleTec.mcip_mng  code 12 = ip-address;
option TeleTec.mcport_mng code 13 = integer 16;
```

```
option TeleTec.ip_log    code 14 = ip-address;
option TeleTec.port_log  code 15 = integer 16;
```

```
option TeleTec.logo_x    code 16 = integer 16;
option TeleTec.logo_y    code 17 = integer 16;
option TeleTec.bg_color  code 18 = integer 32;
option TeleTec.fg_color  code 19 = integer 32;
option TeleTec.VerNumber code 20 = text;
option TeleTec.DateTime  code 21 = text;
option TeleTec.portal_dhcp code 22 = text;
```

```
class "MAG200_boot" {
match if (( option vendor-class-identifier="TeleTecMAG200boot"));
filename "mag200/uImage";
next-server 192.168.1.2;
option root-path "192.168.1.2:/srv/mag200/rootfs";
option ntp-servers pool.ntp.org;
```

```
vendor-option-space TeleTec;
option TeleTec.mcip 224.10.0.50;
option TeleTec.mcport 9000;
}
```

```
class "MAG200_upgboot" {
  match if (( option vendor-class-identifier="TeleTecMAG200upgboot"));
  filename "mag200/Sboot";
  next-server 192.168.1.2;
  option ntp-servers pool.ntp.org;
}

class "MAG200_upglogo" {
  match if (( option vendor-class-identifier="TeleTecMAG200upglogo"));
  filename "mag200/STB-bootlogo.bmp.gz";
  next-server 192.168.1.2;
  option ntp-servers pool.ntp.org;

  vendor-option-space TeleTec;
  option TeleTec.logo_x 0;
  option TeleTec.logo_y 0;
  option TeleTec.bg_color 0x00006498;
  option TeleTec.fg_color 0x00FFFFFF;

  option TeleTec.oppubfile "mag200/op_stb_pub_sign.key";
}

class "MAG200_upgrade" {
  match if (( option vendor-class-identifier="TeleTecMAG200upgrade"));
  filename "mag200/Bootstrap";
  next-server 192.168.1.2;
  option ntp-servers pool.ntp.org;

  vendor-option-space TeleTec;
  option TeleTec.mcip 224.10.0.50;
  option TeleTec.mcport 9000;

  option TeleTec.mcip_img 224.10.0.51;;
  option TeleTec.mcport_img 9001;

  option TeleTec.ip_log 192.168.1.2;
  option TeleTec.port_log 10000;
}

class "MAG200_vendor" {
  match if (( option vendor-class-identifier="TeleTecMAG200"));
  next-server 192.168.1.2;
  option ntp-servers pool.ntp.org;
  vendor-option-space TeleTec;
  option TeleTec.mcip_mng 224.10.0.52;
  option TeleTec.mcport_mng 9002;
}

shared-network test
{
```

```
subnet 192.168.1.0 netmask 255.255.255.0 {
  option subnet-mask 255.255.255.0;
  next-server 192.168.1.2;

  pool {
    range 192.168.1.20 192.168.1.200;

    allow members of "MAG200_boot";
    allow members of "MAG200_upgboot";
    allow members of "MAG200_upglogo";
    allow members of "MAG200_upgrade";
    allow members of "MAG200_vendor";
  }
}
}
```

Example of file mcast.conf

```
[Server]
LogLevel=4
MulticastTTL=1

[Stream: Image bootstrap.signed]
MulticastIPAddress=224.10.0.50
MulticastUDPPort=9000
FileName=Bootstrap
Description=Bootstrap Image
ImageType=1
SerialNumber=1
PacketSize=1456
CycleTime=1000
DataRate=500000

[Stream: Image for upgrade filesystem ]
MulticastIPAddress=224.10.0.51
MulticastUDPPort=9001
ImageName=imageupgrade
Description=upgrade filesystem
SerialNumber=2
DirsPerCycle=128
DataRate=1000000
CycleTime=0
```

Example of file mcast_mcman.conf

```
[Server]
LogLevel=4
MulticastTTL=1
```

```
[Stream: Image bootstrap.signed]
MulticastIPAddress=224.50.0.50
MulticastUDPPort=9000
FileName=Bootstrap
Description=Bootstrap Image
ImageType=1
SerialNumber=1
PacketSize=1456
CycleTime=1000
DataRate=500000
```

```
[Stream: Image for upgrade filesytem ]
MulticastIPAddress=224.50.0.51
MulticastUDPPort=9001
ImageName=imageupgrade
Description=upgrade filesystem
SerialNumber=2
DirsPerCycle=128
DataRate=1000000
CycleTime=0
```

Example of configuration file for adjusting the front panel keys

An example of adjustment is shown below for the second operating regime for WebKit:

```
begin
  repeat=2
  delay=4
  prog=fpsevent
  button=fp_ch+
  config=Key Up Web
end
begin
  repeat=2
  delay=4
  prog=fpsevent
  button=fp_ch-
  config=Key Down Web
end
begin
  repeat=4
  delay=3
  prog=fpsevent
  button=fp_vol-
  config=Key Left Web
end
begin
  repeat=4
  delay=3
  prog=fpsevent
```

```
button=fp_vol+
config=Key Right Web
end
begin
repeat=10
delay=20
prog=fp_xevent
button=fp_power
config=Key alt-KeySym:0x75 Web
end
```

```
begin
repeat=2
delay=4
prog=fp_xevent
button=fp_long_vol+
config=Key ctrl-Space Web
end
begin
repeat=2
delay=4
prog=fp_xevent
button=fp_long_vol-
config=Key Escape Web
end
```

List of changes

The following items were added to the document version 1.05:

- [Graphic Res.](#)
- **Description of the process of program upgrade using “fixed” cyclic multicast group**
- **The variable portal_dhcp is described**