

USRobotics®

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WHITE PAPER

UNDERSTANDING CELLULAR GATEWAY AUTOMATIC PROVISIONING

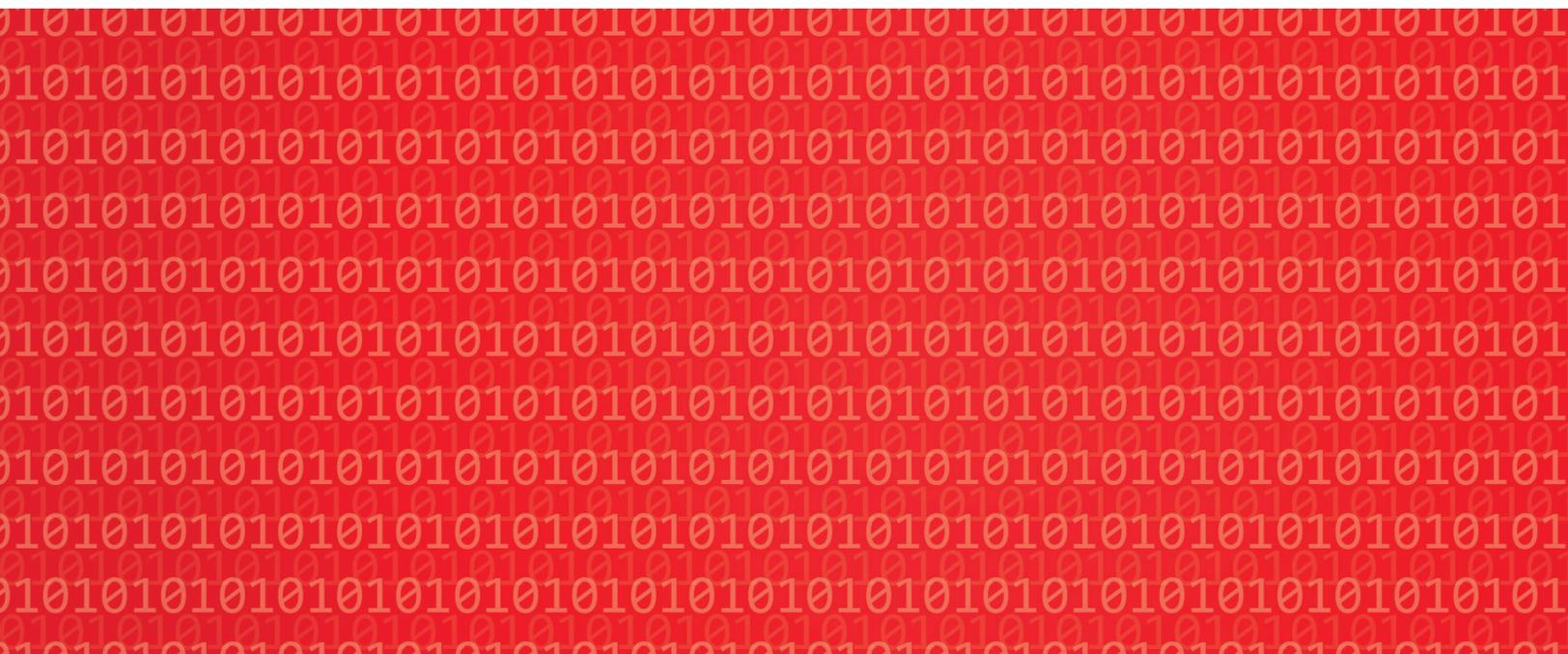
USING THE USR UNIVERSE PROVISIONING SERVER

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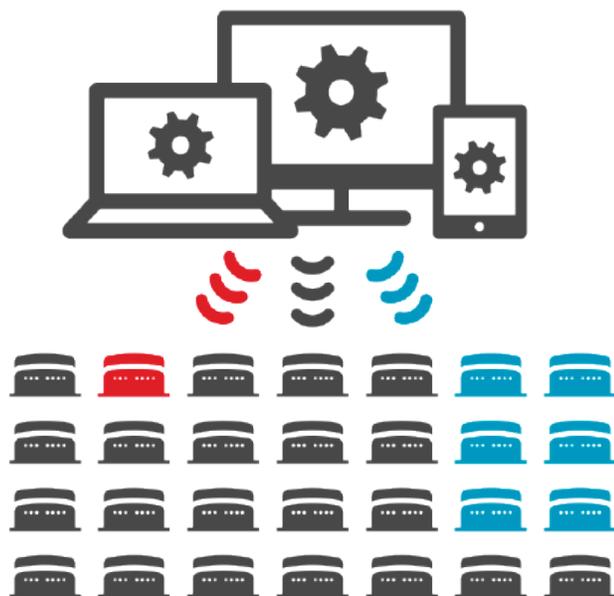
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Understanding Cellular Gateway Automatic Provisioning



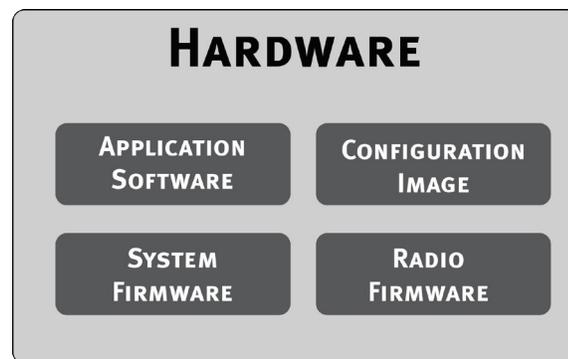
Provisioning is the process of loading a cellular gateway with particular versions of system firmware, application software, and configuration image to prepare the gateway for a specific application or to distribute new features or bug fixes to deployed gateways.

The USR3510/USR803510 cellular gateway base unit uses several methods of provisioning, including a sophisticated system of Automatic Provisioning. This whitepaper describes the multiple provisioning methods and in particular how Automatic Provisioning works and the important considerations about its use.

Gateway Firmware Images

The cellular gateway internal memories contain four slots for firmware images that can be loaded and executed.

- System Firmware
- Application Software
- Configuration Image
- Radio Firmware



The System Firmware and Application Software

The cellular gateway contains an ARM processor that is running a Linux operating system. The operating system executes gateway firmware that controls the basic functionality of the gateway.

The gateway firmware allows loading and executing a custom software application that can add functionality to the gateway.

The Configuration Image

The gateway's embedded Graphical User Interface (GUI) allows an Administrator to configure the operating characteristics of the gateway. The GUI presents text boxes, pull-down menus, and graphical buttons organized into several pages. The Administrator configures the operating characteristics of the gateway by choosing, selecting, or entering individual parameters in the GUI.

The configuration image is an optional and easy way to adjust the settings of the gateway operating parameters all at once instead of one at a time. The configuration image is a file containing all user settings of the gateway, which can be loaded into one or many gateways.

Radio Firmware

Some cellular network operators have unique requirements for devices connecting to their network. The gateway contains a cellular radio module which is running firmware to control how it connects to cellular networks, and may require a specific firmware for connecting to such networks. Some variants of the gateway allow firmware updates for the embedded cellular radio module. This whitepaper is focused on the effects that provisioning has on application functionality, so discussion about provisioning the radio firmware image will be excluded.

NOTE: See the gateway [User Guide](#) for details on setting up provisioning in the gateway and in the USR Universe provisioning server.

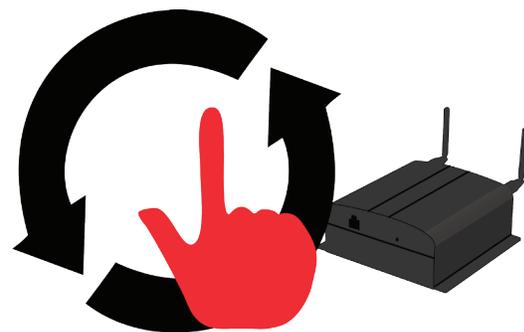
An Overview of Provisioning

Provisioning can be accomplished in four ways:

- Local Manual Provisioning
- Remote Manual Provisioning
- Semi-Automatic Provisioning
- Automatic Provisioning

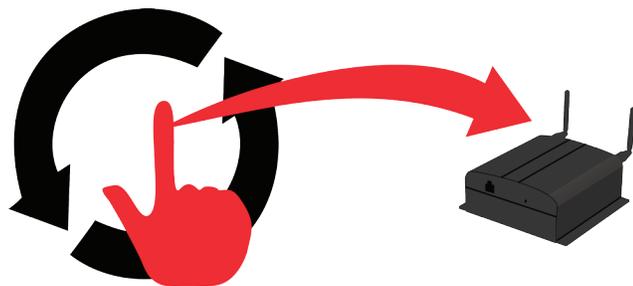
Local Manual Provisioning

A single gateway can be provisioned via its Ethernet port by using the gateway's embedded GUI. An Administrator using a computer with a web browser can log into the GUI to load firmware, software, and configuration files from the computer into the gateway. Local Manual Provisioning is done individually to each gateway.



Remote Manual Provisioning

A single gateway can be provisioned over-the-air by accessing its embedded GUI via the cellular connection. To perform Remote Manual Provisioning, the gateway must be pre-configured before deployment to allow Remote Access, and the IP address of the gateway must be routable from the Administrator's computer. An Administrator using a computer with a web browser can remotely log into the GUI to load firmware, software, and configuration files from the computer into the gateway. Remote Manual Provisioning is done individually to each gateway.



Semi-Automatic Provisioning

Semi-Automatic Provisioning of a single local or remote gateway can be initiated using the **Check for Updates** button on the **Provisioning Tab** of the embedded GUI. However, instead of loading the provisioning files from the local computer, the gateway will check the **USR Universe** provisioning server and download pre-determined versions of firmware, software, and configuration files from the provisioning server if necessary.

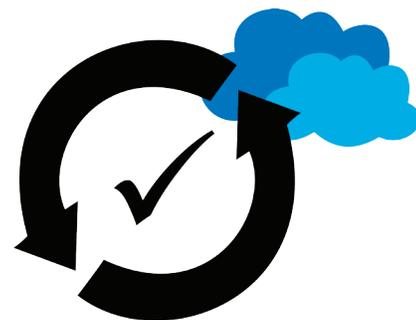
NOTE: When an expansion card (e.g. USR3516-EMU) requires the gateway to run particular versions of firmware and software that are not posted to the **USR Universe** provisioning server, Semi-Automatic Provisioning is not suitable because it will actually **remove** the manually loaded images and render the expansion card inoperable.



Automatic Provisioning

Automatic Provisioning allows any number of gateways to be automatically provisioned over-the-air via their cellular connections using the **USR Universe** provisioning server. Each gateway will check-in with the provisioning server to download pre-determined versions of firmware, software, and configuration files from the provisioning server if necessary.

NOTE: When an expansion card (e.g. USR3516-EMU) requires the gateway to run particular versions of firmware and software that are not posted to the **USR Universe** provisioning server, Automatic Provisioning is not suitable because it will actually **remove** the manually loaded images and render the expansion card inoperable.



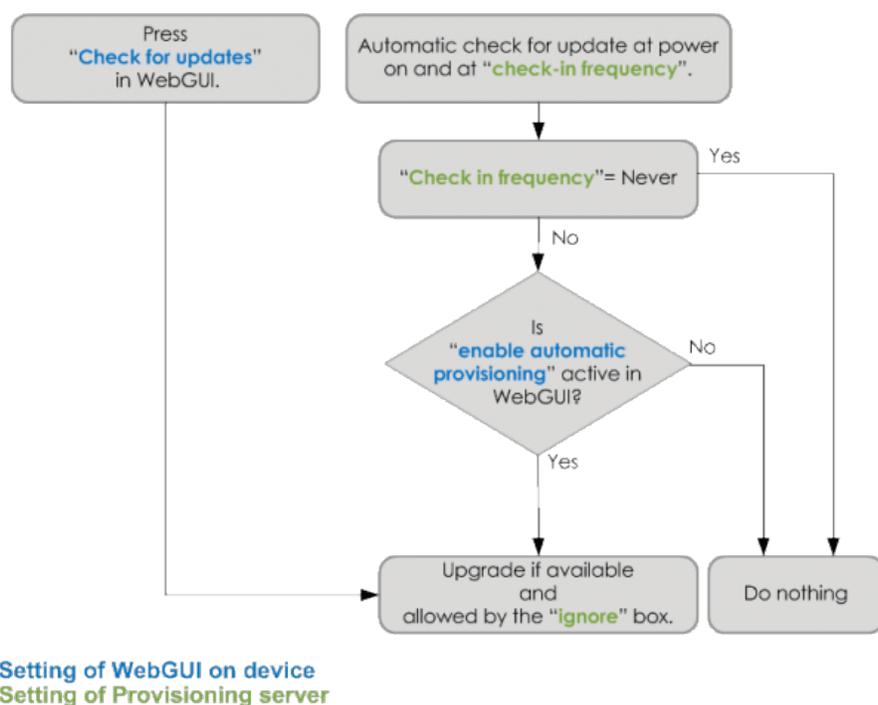
The Automatic and Semi-Automatic Provisioning Process

The main purpose of the **USR Universe** provisioning server is to upload over-the-air firmware, software, and configurations to any number of gateways that are deployed out in the field. Each gateway must be activated (registered) and assigned to a group in the **USR Universe** provisioning server in order to control which provisioning images it will receive.

Automatic Provisioning is enabled in the gateway by default. With Automatic Provisioning enabled, the gateway will attempt to contact the **USR Universe** provisioning server upon power-up, and subsequently on a programmed schedule. The gateway will first try using its Ethernet port to reach the provisioning server. If that route fails, it will try using its cellular connection to reach the provisioning server.

- When Automatic Provisioning commences in a gateway that is registered with the provisioning server, the images in the gateway's group will be the target of the gateway provisioning¹.
- When Automatic Provisioning commences in a gateway that is not registered with the provisioning server, no images from the provisioning server will be downloaded into the gateway.
- When Semi-Automatic Provisioning is initiated in a gateway that is registered with the provisioning server, the gateway will immediately follow the same steps as Automatic Provisioning.
- When Semi-Automatic Provisioning is initiated in a gateway that is not registered with the provisioning server, the latest firmware image in the provisioning server library will be the target but software and configurations images will not.

Automatic Update Flow Chart



¹ Except when a custom image that differs from the group is assigned to a gateway within the provisioning server, making the custom image the target.

Firmware Updates

When a connection to the provisioning server is made, the gateway will check the version of the system firmware target that is stored in the provisioning server. If the gateway's current version does not match the target version that is stored in the provisioning server and "Ignore updates" is not selected, the gateway will automatically download the file from the provisioning server and replace its current version.

Software Updates

The gateway will also check the provisioning server for a software application. If a target is found that is a different application or a different version from the gateway's current application and "Ignore updates" is not selected, the gateway will automatically download the file from the provisioning server and replace its current application. If no target software application is found on the provisioning server and "Ignore updates" is not selected, the gateway will remove any current software application from its system.

Configuration Updates

The gateway will also check the provisioning server for a configuration image. If a target is found and the version doesn't match the gateway's current version and "Ignore updates" is not selected, the gateway will automatically download the file from the provisioning server and apply the configuration settings. If no target configuration image is found on the provisioning server the gateway will maintain its current configuration settings.



Automatic Provisioning - Important Notes and Cautions

The automatic options do have consequences for both enabling and disabling that could include excessive data usage or unintended removal of images or configurations. Consider the following scenarios and refer to the recommendations before choosing a provisioning method.

Excessive Data Usage

Cellular data service generally is billed based on the amount of data transferred. For example, some cellular service plans are billed per kilobyte of data, while some are packaged as a monthly allowance of data with penalties for exceeding the monthly allotment. Most M2M applications require very small monthly data usage, which keeps data service costs very low.

When enabled, Automatic Provisioning will periodically check-in with the provisioning server and may download files via the cellular connection. The check-in process consumes approximately 24kB of data for initial power-up and subsequently 3kB per check-in. But provisioning files are well above 10MB in size, so **the cost of inadvertently transferring provisioning files over the cellular connection may be surprisingly high!**

NOTE: Excessive data usage during manual configuration can also happen for reasons other than provisioning, as explained in this [downloadable PDF](#).

Unintended Removal of Custom Images

Local or Remote Manual Provisioning can be used to manually load firmware, software, and configuration images into a gateway. But Automatic Provisioning and Semi-Automatic Provisioning can **inadvertently remove those manually loaded images and replace them with images found on the USR Universe provision server!**

For example, the USR3516-EMU Modemulator expansion card requires the gateway to run manually loaded firmware and software images, but Automatic Provisioning and Semi-Automatic Provisioning will disable the Modemulator expansion card by removing and replacing those manually loaded images!

Disabling Field Upgrades

Automatic Provisioning is a mechanism for updating the firmware, software, and configuration of any number of gateways that are deployed in the field. Disabling Automatic Provisioning to avoid excessive data usage and prevent unintended removal of custom images will also **prevent updates from being automatically distributed over-the-air to the deployed gateways!**

With Automatic Provisioning disabled, it is still possible to update individual gateways by using Manual or Semi-Automatic Remote Provisioning if the gateways are pre-configured to allow remote access, but **cellular data costs will apply!**

Provisioning Recommendations

There are two recommended approaches for configuring the gateways to prevent inadvertent cellular data usage and unintended removal of manually loaded images:

- Disable Automatic Provisioning
- Ignore updates

Disable Automatic Provisioning

Use this approach when the ability to send over-the-air updates of firmware/software/configuration images to deployed gateways is not required.

Benefits

- ✓ This approach does not consume cellular data checking-in with the USR Universe provisioning server.
- ✓ This approach does not consume cellular data downloading files from the USR Universe provisioning server.
- ✓ Custom images manually loaded into the gateway cannot be automatically overwritten by images on the USR Universe provisioning server.
- ✓ This approach does not require registering each gateway on the USR Universe provisioning server.

Drawbacks

- ✗ Gateways deployed in the field cannot automatically receive important firmware/software/configuration updates over-the-air.

- ✘ When manually configuring the gateway via the embedded GUI, selecting the **Check for Updates** button on the **Provisioning Tab** may cause inadvertent cellular data usage and unintended removal of manually loaded images.

Implementation

- Log into the embedded GUI of each gateway to disable Automatic Provisioning on the Settings tab *before configuring cellular connectivity and before manually loading any firmware or software image*. See Figure 1.
- Don't click on the **Check for Updates** button. See Figure 2.

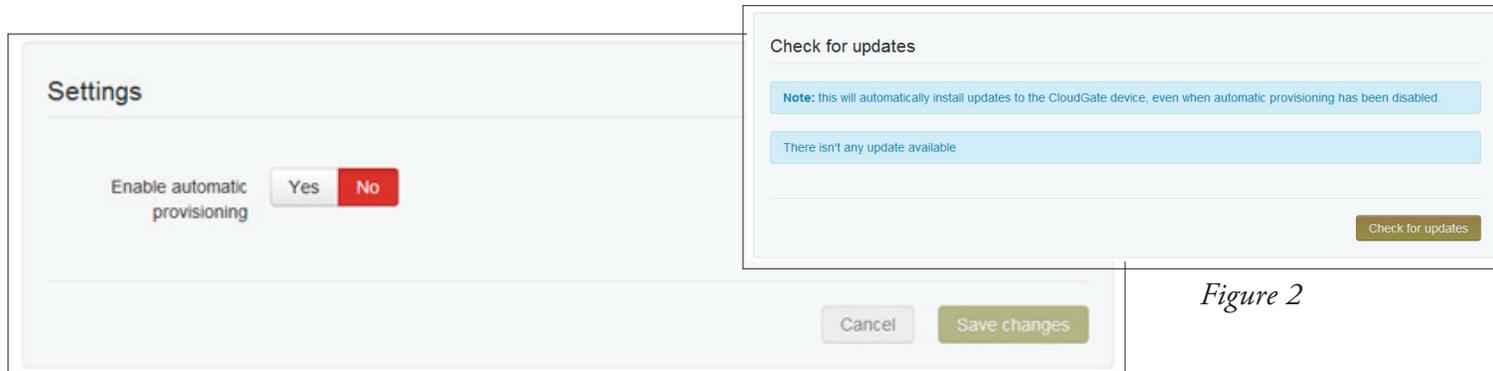


Figure 1

Figure 2

Ignore updates

Use this approach when the ability to selectively update the firmware/software/configuration images of deployed gateways over-the-air is required.

Benefits

- ✓ Selected gateways deployed in the field can receive over-the-air firmware/software/configuration updates.
- ✓ The consumption of cellular data caused by downloading files from the **USR Universe** provisioning server can be managed so that cellular service plan overcharges are prevented.
- ✓ Custom images manually loaded into the gateways will not be unintentionally overwritten by images on the **USR Universe** provisioning server.

Drawbacks

- ✘ This approach does routinely consume a little cellular data checking-in with the **USR Universe** provisioning server.
- ✘ This approach does require registering each gateway on the **USR Universe** provisioning server.
- ✘ This approach does require individually selecting the “Ignore updates” option in the **USR Universe** provisioning server for each image of each registered gateway.

Implementation

- Register each gateway on **USR Universe** provisioning server before powering-up any gateway. See Figure 3.
- Within the **USR Universe** provisioning server, select “Ignore updates” for each image in each gateway before powering-up any gateway. See Figure 4.

- When configuring each gateway, leave Automatic Provisioning enabled. *See Figure 5.*
- When a deployed gateway needs an image update, assign the new image to that gateway or group in the **USR Universe** provisioning server and deselect “Ignore updates” for that image of that gateway. The image will be delivered at the next check-in. *See Figure 6.*

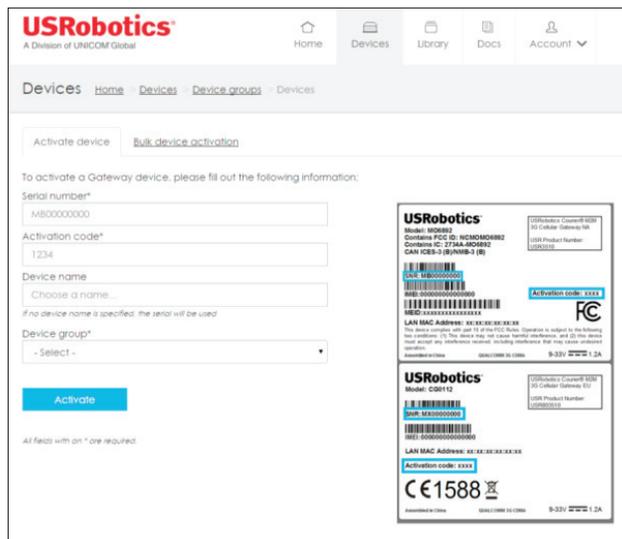


Figure 3



Figure 4



Figure 5



Figure 6

Conclusions

There are several methods for provisioning images to the USRobotics cellular gateway, including automated methods that utilize the **USR Universe** provisioning server. However those automated methods can cause costly cellular data charges and can conflict with the manual provisioning methods, so careful consideration must be given to provisioning methods while configuring the gateway.

Excessive data usage and unintended removal of custom images can be prevented by disabling Automatic Provisioning for applications that will never need to update the firmware, software, or configuration of deployed gateways over-the-air.

Alternatively, excessive data usage and unintended removal of custom images can be prevented, while still maintaining the capability for over-the-air updates, by using the “Ignore updates” function in the **USR Universe** provisioning server.

Contact USRobotics for more information about Automatic Provisioning or any cellular applications that may require mobile terminated connections including remote management, point of sale, utilities, HVAC, SCADA.

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