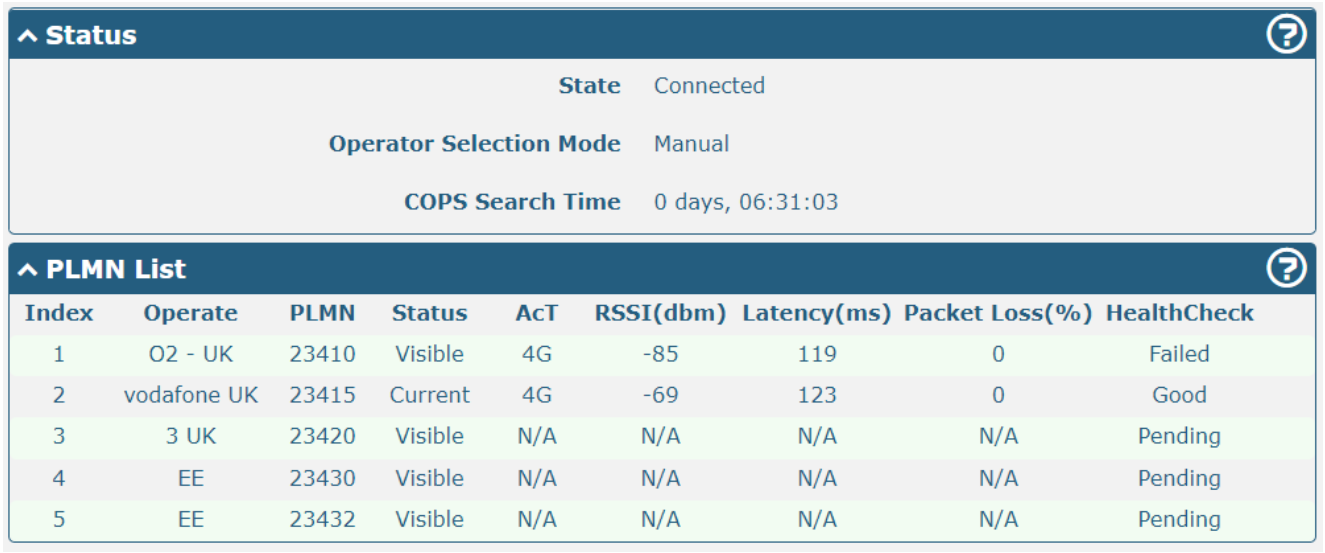
robustel

“SMART Roaming”

Next generation 3G/4G reliability from Robustel

SMART roaming is a new technology available exclusively in Robustel routers to increase GSM connection reliability to the levels required by IoT and M2M solution providers.

Multi-network (aka Roaming) SIMs have often been proposed as the solution to intermittent GSM communications but this is only half the story – a story rarely understood or fully explained by those selling such products.



Status

State	Connected
Operator Selection Mode	Manual
COPS Search Time	0 days, 06:31:03

PLMN List

Index	Operate	PLMN	Status	AcT	RSSI(dbm)	Latency(ms)	Packet Loss(%)	HealthCheck
1	O2 - UK	23410	Visible	4G	-85	119	0	Failed
2	vodafone UK	23415	Current	4G	-69	123	0	Good
3	3 UK	23420	Visible	N/A	N/A	N/A	N/A	Pending
4	EE	23430	Visible	N/A	N/A	N/A	N/A	Pending
5	EE	23432	Visible	N/A	N/A	N/A	N/A	Pending

Figure 1.1 – Status View Screenshot of Smart Roaming

The Problem

In principle, roaming SIMs that give access to all 2G, 3G and 4G networks in any one country sound like a great solution to the limitations of making a cellular internet connection through only one network operator (finite coverage and potential intermittent congestion being the key issues). However, this is only part of the battle.

Network selection is a function of the hardware NOT the SIM card so whilst a Roaming SIM seems like a good idea in principle, it is possible to use a multi-network SIM but still find that your device (router/-modem) does not move to an alternative network when connectivity is lost.

The full details of the process that governs 'network selection' is described in 3GPP standard TS 3GPP 23.122 which can be downloaded from 'portal.3gpp.org'. This will help explain to the more technical reader the full detail and limitations of automatic network selection.

The Solution

All Robustel routers that support 'SMART Roaming' (Currently R2000 and R3000 series) can be configured to check for loss of mobile data communications on the current network and be forced to change to an alternative network within a short period of time. This can save the cost of site visits and provides peace of mind that you have implemented the 'highest reliability' Comms methodology for your connected devices before rolling out a large estate of cellular-connected devices.

SMART Roaming checks not only signal strength but also 'Ping times' and 'Ping completion' to build a more complete picture of the current connection. If the Health-check is failed, the router will dynamically assess the quality of alternative networks and change to the next best if communications are lost or are of a 'low quality'.

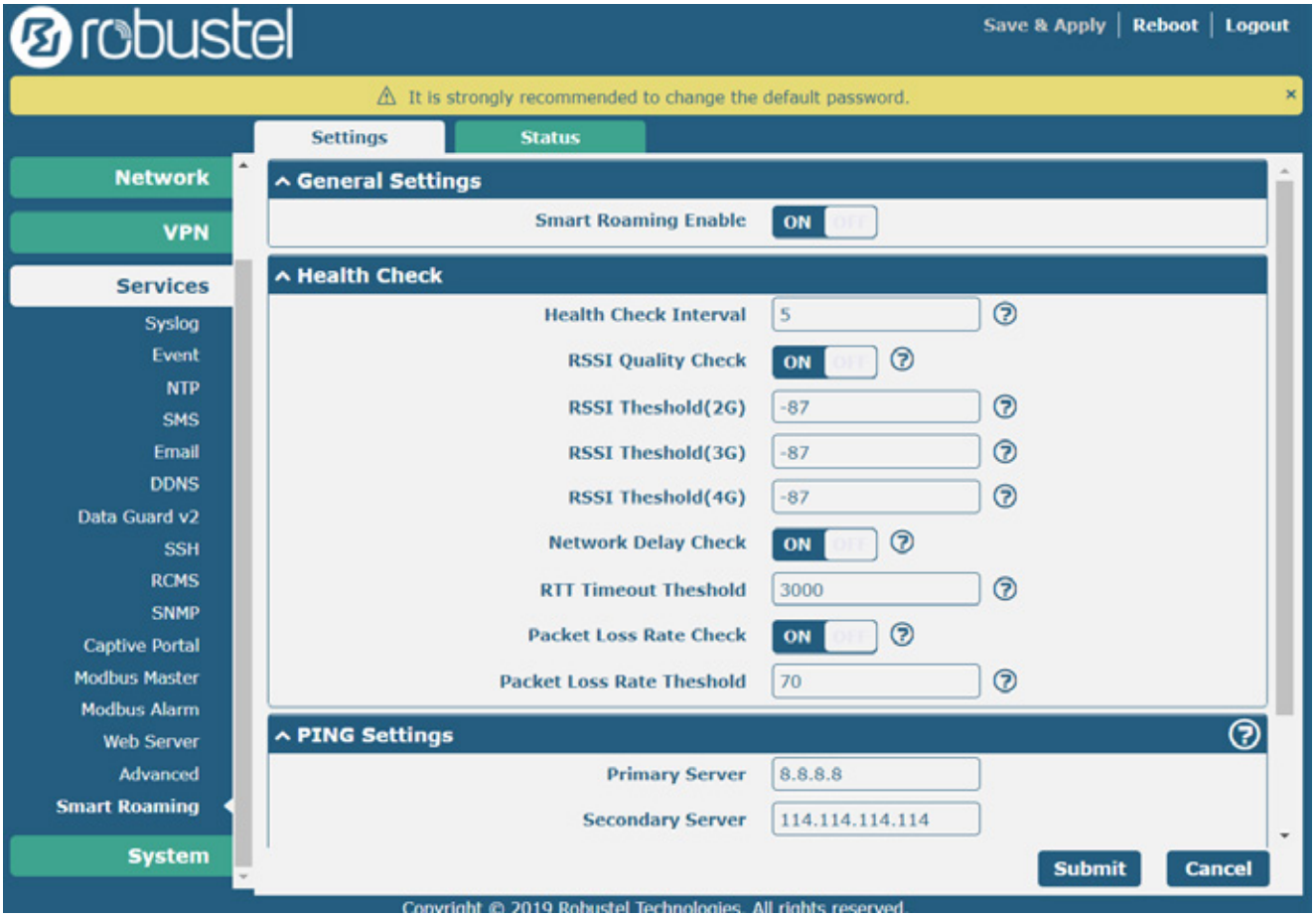


Figure 2.0 – Configuration options in Robutel's Smart Roaming application

SIM types

Firstly, its necessary to understand the fundamental types of SIM being sold into M2M/IoT applications:

1) Single Network SIM

These SIMs provide coverage on a single network typically in a single country. This means that if there is no coverage on the particular network at the installation location (especially if it is in a building) then the communications will not work. Also – if the deployment is multinational then lots of different SIM agreements for different territories need to be agreed which is logistically difficult and virtually impossible to manage at scale.

The traditional solution proposed to these problems has been to offer a roaming or 'multi-network' SIM typically offered by aggregators such as Jersey Telecom, Tele2, Telenor, KPN, Vodafone, Telefonica & others.

What most people don't realise is that not all roaming SIM cards are equal!

2) Steered Roaming SIM

This type of SIM 'can' access multiple networks per country but will favour a specific network or subset of networks for the mobile operator's commercial benefit. The majority of the time, steering it is not implemented for the benefit of reliable communications but to make the scheme less expensive by using 'preferred' networks. This is generally the opposite of what is wanted by IoT service/system providers who need as close to 100% network uptime as possible.

Steering of roaming is a complex subject matter not covered in this document. The primary and simplest solution is to select a good quality 'unsteered' roaming SIM although clever marshalling of steered roaming schemes can help to achieve desirable commercial outcomes.

3) Unsteered Roaming SIM

As the downsides of Steered roaming have become more visible in the market, certain mobile service providers have started to provide and champion 'Unsteered' roaming SIMs. This means the SIM has no preferred network lists onboard and does not suffer operator-side steering at the network level. Essentially, an unsteered roaming SIM is a blank canvas that simply provides access to networks as and when required with no 'loading of the dice'. This is arguably the most preferable starting point for any M2M/IoT application where uptime / reliability is key.

Network selection process

One of the most misunderstood concepts surrounding roaming SIMs is that of network selection.

Contrary to what many people have been told, SIMs do not play an active part in network selection. (excepting those that leverage SIM toolkit applications to achieve such goals but this is not common). Choosing an appropriate network is a function of the hardware and/or how the hardware is told to behave by associated firmware (generally via AT Commands)

There are two fundamental types of network selection:

Automatic network selection

This process is defined by a set of rules in TS 3GPP 23.122 as detailed below:

"The MS(cellular device) selects and attempts registration on other PLMN/access technology combinations, if available and allowable, in the following order:

1	either the HPLMN (if the EHPLMN list is not present or is empty) or the highest priority EHPLMN that is available (if the EHPLMN list is present) ;
2	each PLMN/access technology combination in the "User Controlled PLMN Selector with Access Technology" data file in the SIM (in priority order);
3	each PLMN/access technology combination in the "Operator Controlled PLMN Selector with Access Technology" data file in the SIM (in priority order);
4	other PLMN/access technology combinations with received high quality signal in random order;
5	other PLMN/access technology combinations in order of decreasing signal quality.

Figure 2.1 – Automatic network selection process – step by step

These network selection rules were originally defined many years ago and do not use the ability for TCP/IP communications to work as an indicator of a usable network. This means the cellular device could be on a network with good signal strength but due to other reasons there is no ability to transmit data. This is extremely undesirable for any IoT/M2M service provider.

Another critical point is that prior to this selection process, the hardware will always try to use the "last known good network" or RPLMN (Registered PLMN) which means that even a reboot will not necessarily push an unconnected system into a working state. The RPLMN concept could mean that a router keeps attaching to a network without working Data Comms due to the failings of the automatic network selection process. Net effect of this is quite simply loss of Data comms.

This very obscure point is commonly not understood and has big implications for those expecting everything to 'just work' when a roaming SIM is used with automatic network selection.

The automatic network selection process has no empathy for packet-switched Comms so an application that sees good signal strength but cannot communicate with a server on the internet will continue in a state with no connectivity and will not automatically recover.

To avoid this problem, some supplementary logic is required in the device firmware.

It is this fundamental issue that Robustel's 'SMART Roaming' Application aims to solve using the simplicity of Automatic network selection but supplementing it with Health-checks and the use of Manual network selection to make sure reliability is as high as it possibly can be.

Strongest Signal Myth

It has become more and more common to hear the following statement or similar from vendors of unsteeered roaming SIMs – especially from their Sales/Marketing departments:

"This SIM will connect to the strongest network so it's much more reliable than other SIMs."

As demonstrated in this document, the network selection process is unfortunately more complicated than this simple soundbite and it is demonstrably wrong for the following reasons.

a) SIMs do not actively connect to anything. Nor do they make decisions about network selection in their own right – this is a function of the cellular module/router that has been coded to follow TS 3GPP 23.122 process. SIM cards are effectively just a repository of files.

b) From Figure 2.0 above, step (iv) clearly states that networks are selected from "at random" – not strongest signal first. There is a very good reason for this design. If every device always went to the best signal by RSSI then the chance of saturation is higher than if roaming devices choose at random from all available cells so long as they have good ("high quality") signal strength.

Manual network selection

In comparison, manual network selection is relatively very simple as compared to automatic network selection. A device can request connectivity on a specific network and so long as registration for the appropriate services is allowed by the SIM/provider, then a connection is made.

At this stage, it would be reasonable to ask,

"Why don't all M2M applications use manual network selection?"

A lack of understanding by hardware manufacturers combined with a relatively high level of risk / complexity in the development process for such subroutines means many shy away from adding such 'polish' to their connected products.

Robustel's 'SMART Roaming' overcomes the limitations of Automatic Network selection to allow Cellular IoT Devices that require high uptime to connect with confidence.

How to trial Smart Roaming

Smart Roaming is one of the many Apps available for Robustel's router Operating System – RobustOS.

The App is currently available for the R2000 and R3000 series routers and can easily be installed by the user through the APP Centre menu in the router interface.

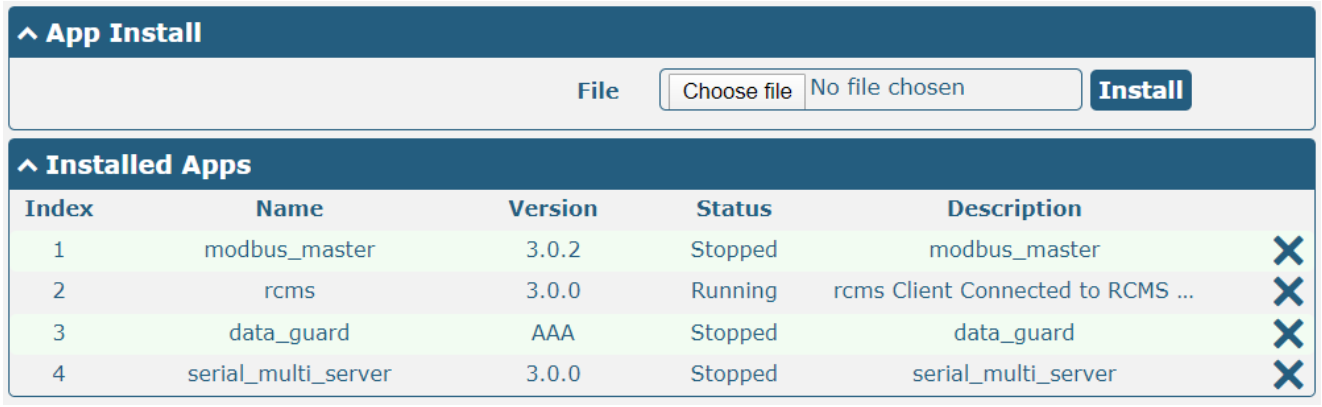


Figure 3.0 – 'App Centre' screenshot showing installed apps, version and status

For production volumes, Robustel can provide Smart Roaming pre-installed along with a custom configuration giving customers a 'zero touch' deployment.

If you would like more information on Smart Roaming or would like a copy of the Smart Roaming application, please contact your local Robustel representative.