

**WIRELESS FAMILY DEVICES
ZB-CONNECTION
Z-CONFIG SNIFFER VERSION**

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Introduction

Z-Config (Sniffer version) is a Personal Computer program which permits to analyse a ZigBee Network.

Z-Config allows you to view in graphic way the level of quality of the radio connection between Routers that make up a specific Network.

It requires that a special device named "Router-Sniffer" is connected to the Personal Computer. This link is made through a USB connection.

System Requirements

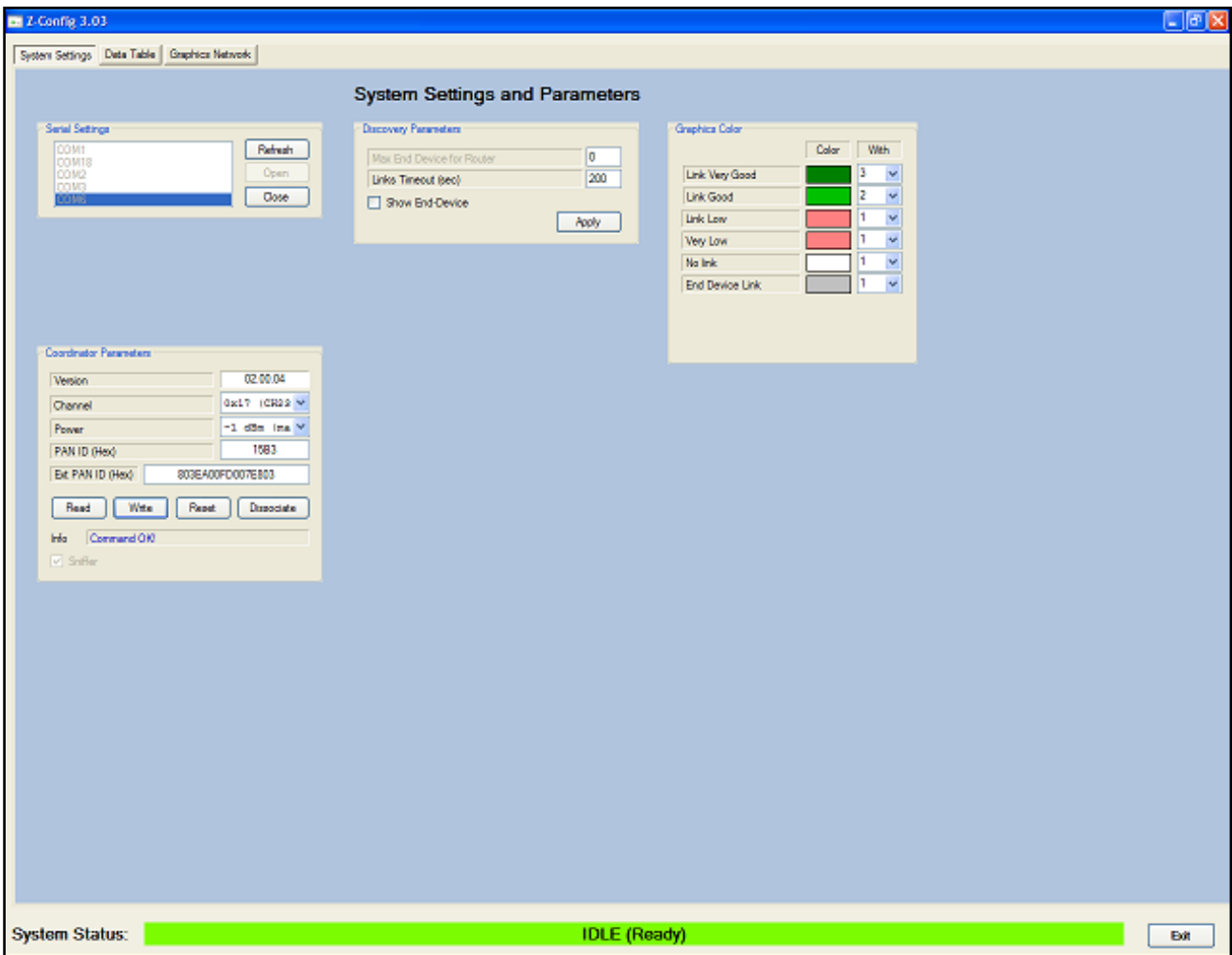
Z-config requires a Personal Computer equipped with Microsoft Windows 98, 2000, XP, XP SP2.

The low use of memory resources (hard drive and ram) allows the installation and normal operation over any PC of last generation.

The installation of the program involves the installation of DotNetFramework version 2.0

Starting the program

At start Z-Config shows this screen:



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Main windows of the program

The program is divided into 3 main windows. The selection is made with the three buttons in the top left corner of the program.



System Settings:

This window contains the settings for the serial communication port, the Network settings and the settings of the graphics window "Network Graphics".

Data Table:

This window shows the table of nodes present in the Network and the communications between Router-Sniffer and the other nodes.

Graphics Network:

This window displays in a graphic way the connection levels between devices on the Network.

Main Window "System Settings"

This window consisting is several frames:

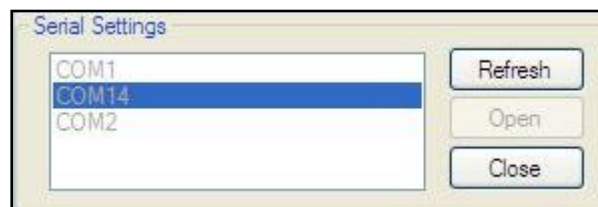
Serial Settings:

This frame manages serial ports opening and closing relatively to the Z-Config communication with Router-Device.

If there are multiple ports, and it is not clear which one belongs to the Router-Sniffer follow this procedure:

Disconnect the device, press the Refresh button, re-connect the Router-Sniffer and then press the Refresh button.

Router-Sniffer just connected should appear in the list and should be easy to locate it.



Network Parameters

The Network Parameters are:

Transmit Channel (value ranges from 11 to 26).

PanID (Network Address) (value ranges from 0 to 32767).

Extended panID (Network Address) (value on 8 bytes).

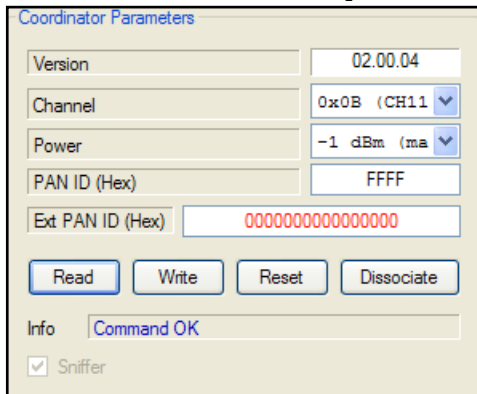
The Network Parameters selected on Z-Config must be the same of the Network that you want to analyze.

To know how to get the Network Parameters of the Network you want to analyze see the last paragraph of this document.

When it is pushed the "Read" button (and when it is opened the serial connection) Z-Config reads the Network Parameters of the Router-Sniffer coupled to the Personal Computer.

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If the Network Parameters are not set (Router-Sniffer new or before dissociated) the channel shows the default value 0x0B (CH11), the panID shows the default value FFFF and Extended panID is whole empty.



Coordinator Parameters

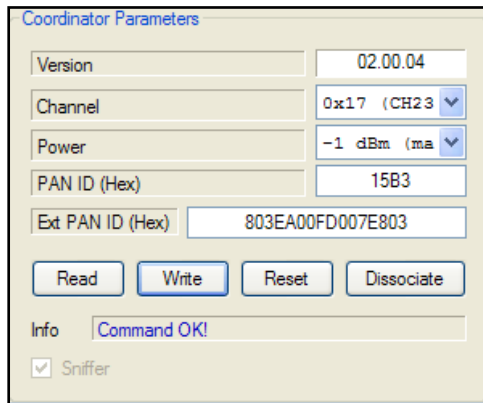
Version	02.00.04
Channel	0x0B (CH11)
Power	-1 dBm (ma)
PAN ID (Hex)	FFFF
Ext PAN ID (Hex)	0000000000000000

Read Write Reset Dissociate

Info Command OK

Sniffer

After setting Network Parameter (channel and panID) , button "Write" save these values in the Router-Sniffer and force it to connect to the desired Network. Set only channel and panID, the extended panID is read from the network itself.



Coordinator Parameters

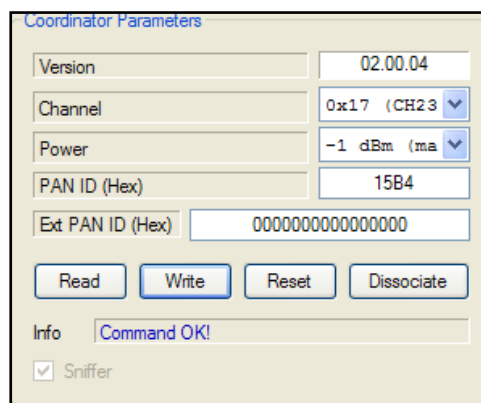
Version	02.00.04
Channel	0x17 (CH23)
Power	-1 dBm (ma)
PAN ID (Hex)	15B3
Ext PAN ID (Hex)	803EA00FD007E803

Read Write Reset Dissociate

Info Command OK!

Sniffer

If channel and panID are wrong and don't belong to any networks in closeness of Router-Sniffer the extended panID is completely empty.



Coordinator Parameters

Version	02.00.04
Channel	0x17 (CH23)
Power	-1 dBm (ma)
PAN ID (Hex)	15B4
Ext PAN ID (Hex)	0000000000000000

Read Write Reset Dissociate

Info Command OK!

Sniffer

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It is also possible to change the power transmission of the Router-Sniffer, but it is not meaningful, it is recommended to leave the maximum value (-1 dB).
Button "Reset" causes the reset of the Router-Sniffer.
Button "Disassociate" causes the disassociation of the Router-Sniffer from the current Network with the result of the initialization of the Network Parameters.

Note: If the joining processor the disassociation process has been completed successful, a message OK appears in the info box.

Note: After having programmed the Network Parameter (by pressing the button "Write") it is suggested, for a perfect initialization of the tables of the program, quit and re-open Z-Config.






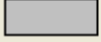
Graphics Colour

This frame handles the appearance of the link lines among nodes in the "Network Graphics".

You can associate the quality of the radio link to the line thickness and the line colour.

The line's thickness can range from 1 (thin line) to 5 (thick line).

The line's colour may be chosen in a palette of standard colors.

	Color	With
Link Very Good		3 <input type="button" value="v"/>
Link Good		2 <input type="button" value="v"/>
Link Low		1 <input type="button" value="v"/>
Very Low		1 <input type="button" value="v"/>
No link		1 <input type="button" value="v"/>
End Device Link		1 <input type="button" value="v"/>

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Main Window "Data Table"

This window shows a table which includes all the devices of the Network.

At the start, the table contains only "Router Sniffer" device.

Button "Start Discovery" performs nodes Discovery.

The process continues indefinitely until the pressing of "Stop Discovery" button.

The examined node is highlighted by the darkening of the specific row.

ID	MAC	SHORT	Type	n_Neighbou	Neighbours	GHOST
0	000D6F0000053559	EF26	Sniffer	3 of 7	0000 3FB4 4352	No
1	000D6F0007110901	0000		7 of 7	3FB4 4352 4CCB E0E7 EA90 EF26 FBA1	No
2	000D6F00003E2001	3FB4	Router	7 of 7	0000 4352 4CCB E0E7 EA90 EF26 FBA1	No
3	000D6F000099FA1	4352	Router	8 of 8	0000 3FB4 4CCB 8920 E0E7 EA90 EF26 FBA1	No
4	000D6F00000DE15F	4CCB	Router	11 of 11	0000 3FB4 4352 8920 AA53 C47F E0E7 E266 EA90 ...	No
5	000D6F0008040642	8920	Router	7 of 7	4352 4CCB AA53 C47F E0E7 E266 EF26	No
6	000D6F00000DE152	E0E7	Router	11 of 11	0000 3FB4 4352 4CCB 8920 AA53 C47F E266 EA90 ...	No
7	000D6F0009042801	EA90	Router	9 of 9	0000 3FB4 4352 4CCB C47F E0E7 E266 EF26 FBA1	No
8	000D6F0008092544	FBA1	Router		-----	Yes
9	000D6F0008122201	AA53	Router	8 of 8	4CCB 8920 C47F E0E7 E266 D6D5 AAE1 6C7D	No
10	000D6F0008040641	C47F	Router	6 of 6	4CCB 8920 AA53 E0E7 E266 5113	No
11	000D6F000012F659	E266	Router	10 of 10	4CCB 8920 AA53 C47F E0E7 EA90 EF26 FBA1 DB1F ...	No
12	000D6F0000130FC8	D6D5	End Device		Child of <AA53>	No
13	000D6F0000130FCA	AAE1	End Device		Child of <AA53>	No
14	000D6F000012F502	6C7D	End Device		Child of <AA53>	No
15	000D6F0000130FA3	5113	End Device		Child of <C47F>	No
16	000D6F000012F4F3	DB1F	End Device		Child of <E266>	No
17	000D6F0000130FA6	8C45	End Device		Child of <E266>	No

Backgrounds:

All ZigBee Router transmit at periodic intervals a radio message (approximately every 16 seconds).

This message is called "Neighbour Exchange", this is basically a presence announcement.

All Routers in "radio closeness" receive these messages and use them internally to generate and keep a table called "Neighbours Table".

Z-Config during the Network Discovery phase, captures "Neighbours Table" data from all the Routers that make up the Network.

Network Discovery is started with the extraction of the Router-Sniffer's "Neighbours Table".

Each new Router noticed in the "Neighbours Table" of a Router, creates a new row in "Data Table".

Each Router existing in "Data Table" is inquired about its own "Neighbours Table".

At the end of the process, Network Discovery is restarted.

Purpose of "Data Table" columns:

ID:

Progressive number.

MAC:

EUI64 node address. It represents the unambiguous address of the device (on 8 bytes). This address is set at the manufacture time of the device, it cannot be overwritten or deleted during the whole life of the device. This number is printed in hexadecimal notation.

SHORT:

Network address of the device. This address might change during regular operation. This address is used to send and receive radio messages to and from each node. This number is printed in hexadecimal notation.

Type: Type of device

N_Neighbours:

Number of neighbours nodes in "radio closeness".

Neighbours:

Network addresses of the neighbours nodes. These data are used to draw the graphics links in the window "Network Graphics". These numbers are printed in hexadecimal notation.

GHOST:

This column prints the communication problems. String "No" manifests that the device is working properly. String "Yes" manifests that the device did not respond in the maximum number of attempts. When a device is in "GHOST" condition it is no more examined by Z-Config.

Purpose of "Data Table" Parameters:

Command rate [mS]:

Interval between the receiving of a reply and transmitting of the subsequent request (minimum 100ms).

Timeout Time [mS]:

Awaiting response time, surpassed it Z-Config executes a further attempt.

Command Retry:

Number of consecutive unanswered transmission attempts. After this number of retry the device is declared "Ghost".

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Purpose of "Data Table" buttons:

Refresh Table:

Clear the table contents.

Start Discovery:

It starts Network Discovery.

The process continues indefinitely until the program is closed, or it is pressed "Stop Discovery" button.

Stop Discovery:

It Stops the Network Discovery.

Apply:

Apply changes in the operating Parameters.

Clear Ghost:

It deletes all the "Ghost" attributes found during the Discovery of the Network.

Clear Table

It deletes all the "Data Table"

Print Table

Print menu

Operating Notes:

The information summarized in the table "Data Table" are the only one that Z-Config can extract from the nodes of the Network.

All "application layer" data as logical number, operating Parameters or other, cannot be extracted by Z-Config.

The Network Discovery process causes presence of many radio messages among Router-Sniffer and all nodes in the Network.

This generates a considerable radio traffic that might interfere with the standard messages of the Network.

It is recommended to not leave indefinitely the Network Discovery process functioning but make it work only for the necessary time of examination.

At the first activation of the Network Discovery or after a reset of Router-Sniffer, some Router might show void MAC (0000000000000000).

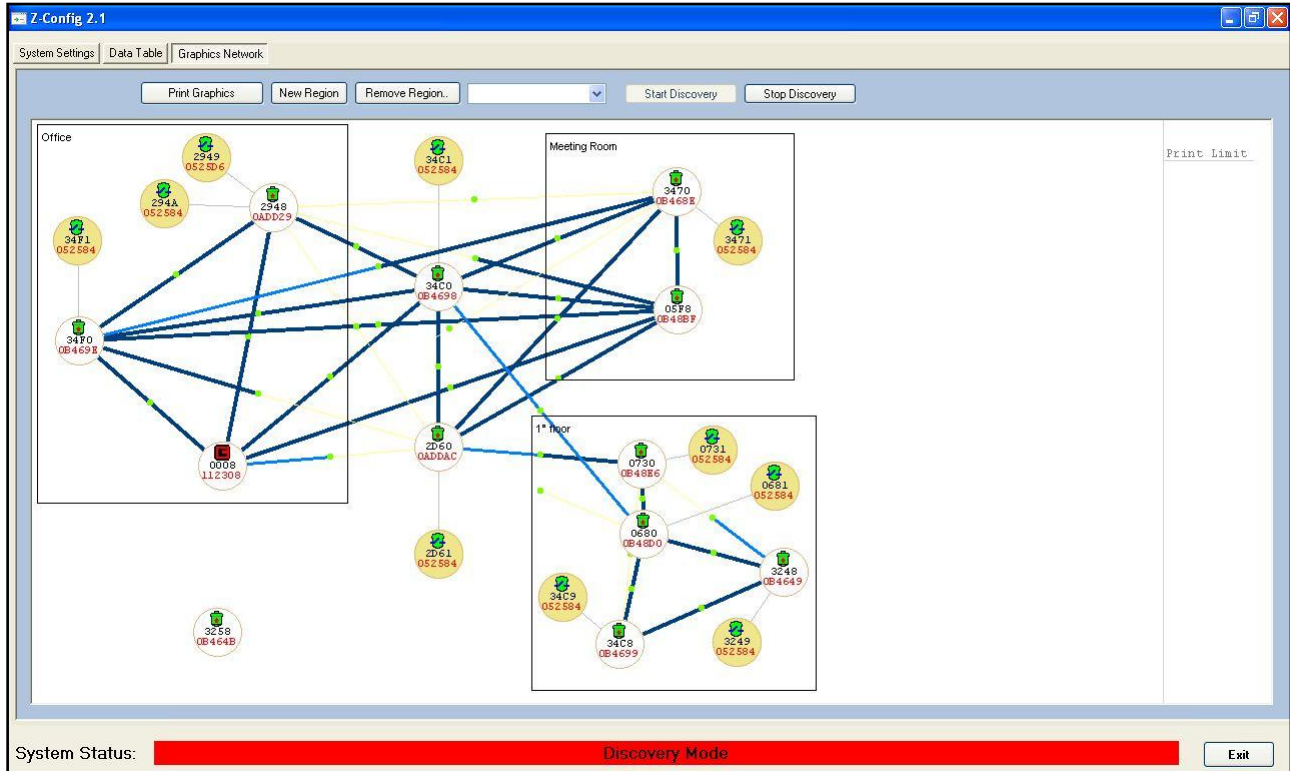
To solve this hitch wait for the complete Discovery of all Router, then stop the process, wait a few seconds, press the button "Clear Table" and then start again the Network Discovery process.

Before starting the first Network Discovery process or after a change in the Network topology (adding or moving a Router), it is advisable to obtain more precise information, that all the Routers of the Network are resetted.

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Main Window "Graphics Network"

This window shows in a graphical way the "Data Table" information. With these data, it is possible to reconstruct with good accuracy the physical structure of the Network.



Explanation of the graphic symbols:



Icon that represents the Router-Sniffer.
In black-ink is printed the Network Address (SHORT).
In red-ink is printed the MAC address (only last six char).
All these numbers are represented in a hexadecimal format.



Icon that represents the Router.
In black-ink is printed the Network Address (SHORT).
In red-ink is printed the MAC address (only last six char).
All these numbers are represented in a hexadecimal format.
Note: if SHORT = 0000 then node is the coordinator (Gateway).



Icon that represents the End-Device.
In black-ink is printed the Network Address (SHORT).
In red-ink is printed the MAC address (only last six char).
All these numbers are represented in a hexadecimal format.

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Link among Routers

Thickness and colors of lines between Routers show the reciprocal radio link quality (LQI).

At the middle of the line, there is a green point.

The two segments of the line symbolizing the two levels of reciprocal quality.

The segment bound to the node displays the quality which the node detects messages from the other one.

Links are often asymmetric, so often lines have different colors (and/or different widths) segments.

This happens if one of two Routers perceives the other one better (or worse) than the other one perceives the first.

The reason is manifold, for example, if one of two Routers has radio power amplifier (PA) or has antenna with different gain.

Link among Router and End-Device

Concerning the link between Router and End-Device the line does not give information about the quality of the radio connection but only expresses which Router is the End-Device's parent.

Purpose of "Graphics Network" buttons:

Print Graphics:

Print menu

New Region:

It draws a rectangle in the graphical window. The name and the size of this rectangle are customizable.

Remove Region:

It deletes a rectangle in the graphical window.

Start Discovery:

Same function of the button in "Data Table" window.

Stop Discovery:

Same function of the button in "Data Table" window.

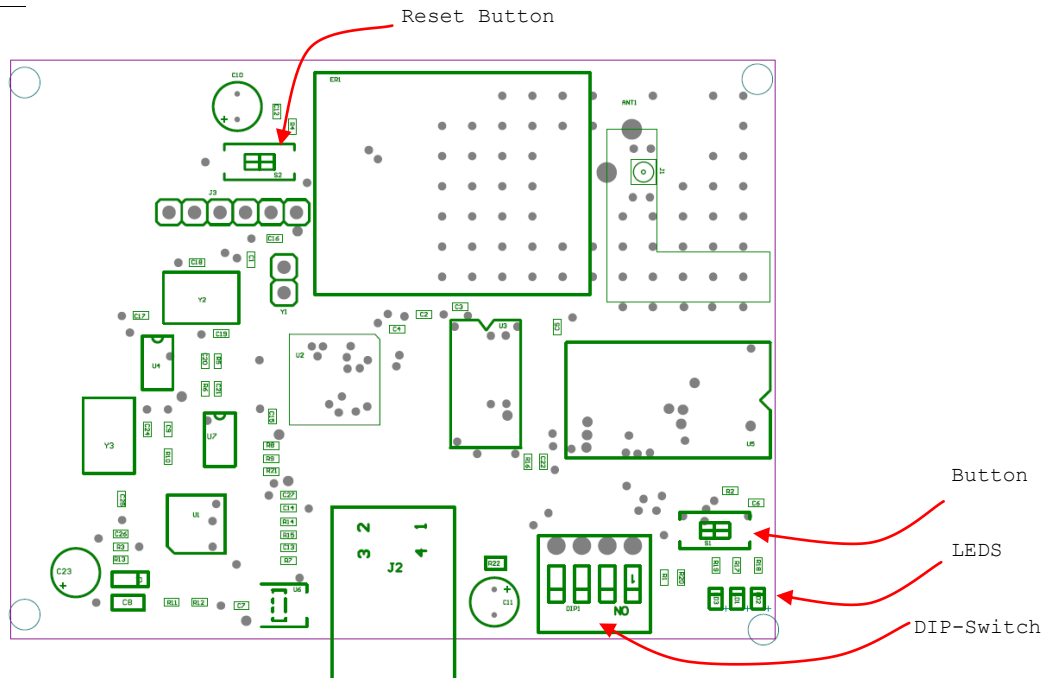
Nodes Recognition

Recognition of a node can be made through its MAC address printed on the device. In fact, MAC is the only unique value showed by Z-Config. Alternatively, the identification can be made by indirect methods (for example, turning off a Router and seeing which node in "Data Table" has become GHOST after some time).

Router-Sniffer

Router-Sniffer is built on the same board of the Gateway-Usb. It has a completely different firmware.

Device Layout:



Note:
Button and DIP-Switch have no associated role.

LEDS behavior:

At power up of Router-Sniffer or reset the leds are lighted for three seconds, then they blink for other three seconds.

Disassociated Router-Sniffer: All leds blink together.

"in Network" Router-Sniffer: Only middle led blinks.

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Using Z-Config

Z-Config is used mainly to evaluate the relative position of each Router of a ZigBee Network.

It allows you to recognize any weaknesses in the Network.

Weakness recognizing example:

The following illustration shows a Network constituted by 10 Routers, the Router-Sniffer and two End-Device.

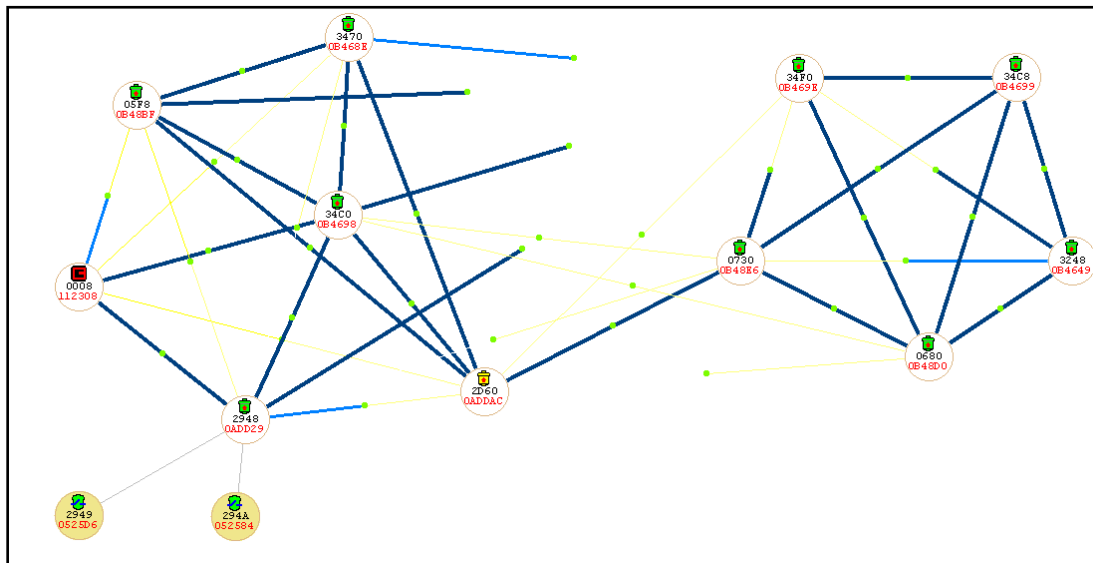
As you can see the Network is separated into two subnets.

The two subnets are connected by a single link of good quality (the blue line connecting the node 2560 to node 0730).

All other links are low link quality; in fact, they are represented by yellow lines.

This condition denotes a Network with a possible source of weakness.

Indeed, in presence of temporary barriers between node 2560 and node 0730, the two subnets can be momentarily isolated.

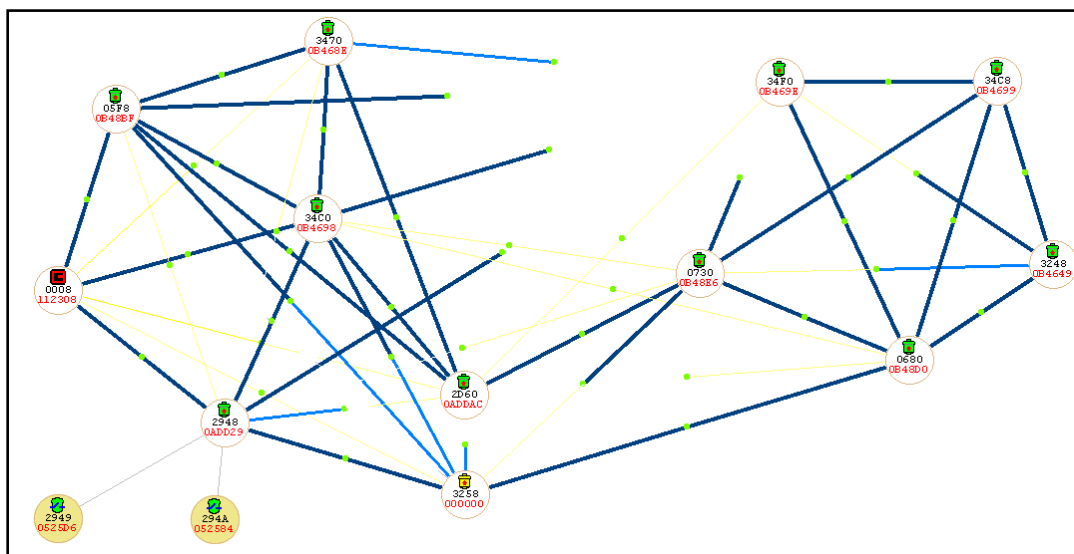


It is advisable to correct such situations, and, where is possible, to add a Router in order to increase the number of links between subnets.

An alternative to installing more Router is to move some of the current ones in better positions.

The following illustration shows the identical Network where it is switched on a new Router in a strategically position.

In this situation, as you can see, the two sub nets are connected by a further connection of good quality (the blue line that links the new node 3258 to node 0680).



Knowing the Network Parameters for ModBus-type Network

You can know the Network Parameters of a Modbus Network by querying the Gateway.

The value of channel can be obtainable by reading the Gateway register InputStatus[3].

The value of panID (Network Address) can be obtainable by reading the Gateway register InputStatus[4].

The value of extended panID (Network Address) can be obtainable by reading the Gateway register InputStatus[17],[18],[19],[20].

Note:

Before performing a Network Discovery with Z-config is recommended to reset all the Router and then wait about a minute.

This can be done easily by sending a reset command via radio to all Routers (Broadcast Message).

To do it, you have to set the command password value 16785 in Gateway register HoldingRegister[0] and then activate Gateway register flag CoilStatus[0].

After this sequence you have to reset also the Gateway (with command password value 6512).

For more detailed information refer to the Modbus Gateway documentation.