Getting Started:

IP Settings in general application

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Control Systems and Components

Document History

Date	Author	Modification
13.01.2010	S.Ki, TCS	- Creation of the document (Version 1) - Basic explanation of IP the functioning
18.10.2010	S.Ki, TCS	- Correction for the release of this document
16.02.2010	S.Ki. TCS	- Correction of the binary value of 168 (1010 1000)

Contents

1 Introduction

This document gives you a basic explanation of the IP (**I**nternet **P**rotocol) applied on the SAIA devices which contains TCP/IP interface (PCD3.Mxxxx or others).

The Internet Protocol is a complex communication protocol between different networks. This document helps you only to have an overview how a communication over IP is done.

The informations given in this document could also be valid for general application in different devices sytems (no-SAIA).

2 What is the IP settings ?

The Internet network consists of several networks which are called **Subnets** (sub-networks).
A subnet means a private network, firm network, a home network or still other type of network. To differentiate several subnets, every subnet has its own ***Subnet Address***.
Each station of a same subnet has the same ***Subnet Address***.
Each station of this subnet possesses its own ***Host ID*** (identification) to be differentiated from the other stations of this same *Subnet*

There are **3 specific settings** which allow a communication over **IP**:

1) **IP Address**
2) **Subnet Mask (IP Mask)**
3) **Default Router (Default Gateway)**

2.1 IP Address

→ Contains the ***Host ID*** on a subnet
→ Contains the ***Subnet Address*** in the which the station belongs

2.2 Subnet Mask (IP Mask)

→ Common for all station of the same subnet
→ With the IP Address it allows to calculates the ***Subnet Address*** and the ***Host ID***

2.3 Default Router (Default Gateway):

→ It contains the address of the ROUTER which acts as gateway for the information exchanged between the subnet and an external network/subnet.

2.4 How to know the Subnet Address

For example we configure in a station with the 3 following IP settings:

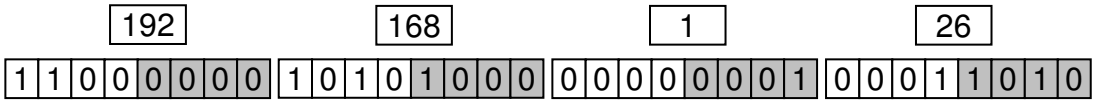
IP Address: **192.168.1.26**
Subnet Mask: **255.255.0.0**
Default Router: **192.168.1.1**

The Default router is not used to obtain the Subnet Address and the Host ID. Only the **IP Address** and the **Subnet Mask** are necessary to do this.

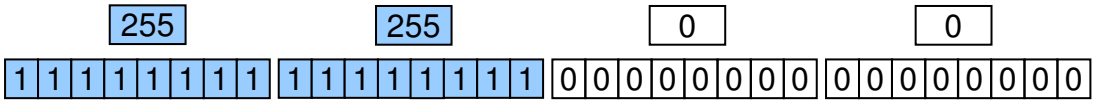
To obtain the Subnet Address, you have to make an "**And Bitwise**" binary operation between the binary representation of the IP Address and Subnet Mask.

The "**And Bitwise**" binary operation executes an "**And**" binary operation bit to bit of 2 binary values.

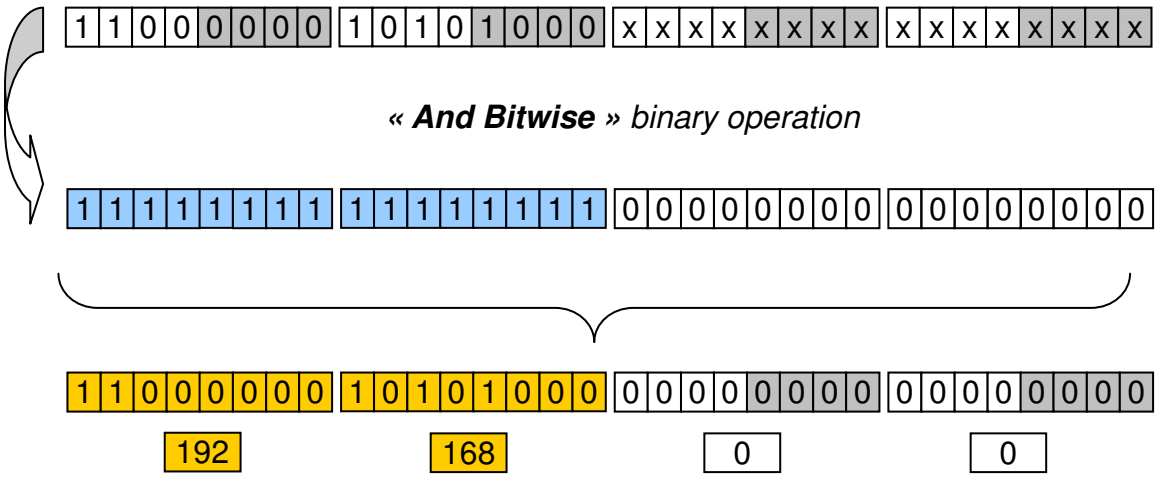
a) Binary **IP Address:**



b) Binary **Subnet Mask**:



c) Calculated **Subnet Address** wit the **And Bitwise** binary operation:



d) Result: The **Subnet Address** of this station is: **192.168.0.0**

2.5 How to know the Host ID

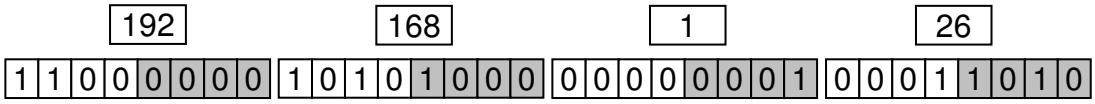
For this example we use the same IP setting as in section 2.4 .

The process to calculate the **Host ID** is almost the same as for the **Subnet Address.** There is an additional binary operation to do on the Subnet Mask.

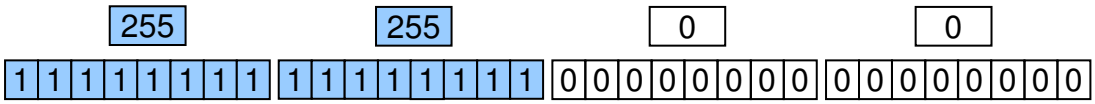
Here to obtain the *Host ID*, you have to make the "**And Bitwise**" binary operation between the *IP Address* and the "**Complement**" of the *Subnet Mask.*

The "**Complement**" binary operation of a value inverts all bits of this value.

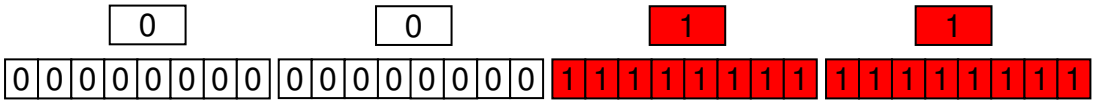
a) Binary **IP Address:**



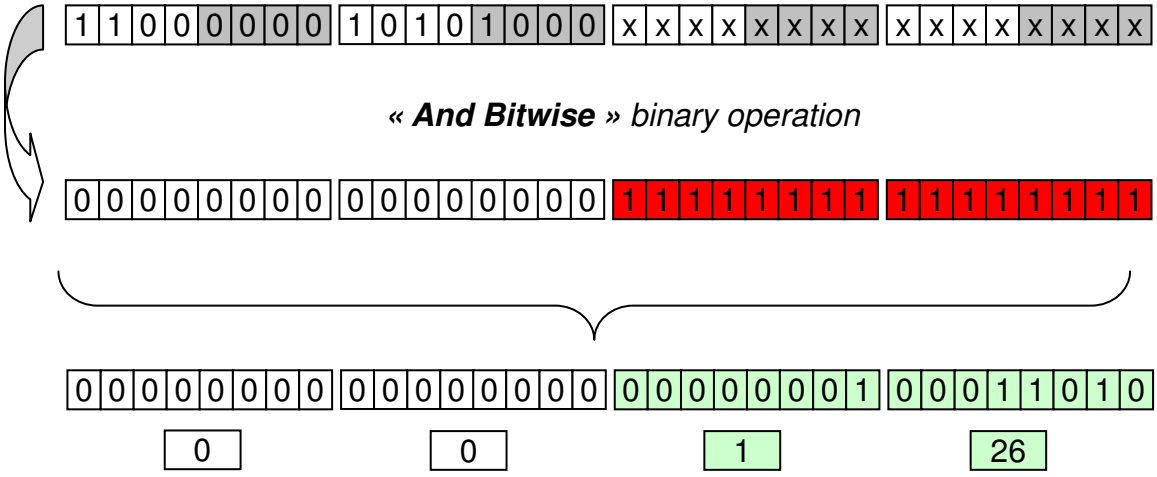
b) Binary **Subnet Mask**:



c) "**Complement**" of the Subnet Mask: (additional binary operation)



d) Calculated **Subnet Address** wit the **And Bitwise** binary operation



e) Result: The **Host ID** of this station is: **0.0.1.26**
(→ in the subnet **192.168.0.0**)

3 Which IP settings for a *private network* ???

A *private network* is also considered as a *Subnet* and it exists 3 types of IP settings to use for a *private network* according to the **RFC 1918.**

3.1 For 65'536 stations on a one private network

IP addresses:	from	**192.168.0.0**
	to	**192.168.255.255**
Subnet mask:		**255.255.0.0**

3.2 For 1'048'576 stations on a one private network

IP addresses:	from	**172.16.0.0**
	to	**172.31.255.255**
Subnet mask:		**255.240.0.0**

3.3 For 16'777'216 stations on a one private network

IP addresses:	from	**10.0.0.0**
	to	**10.255.255.255**
Subnet mask:		**255.0.0.0**

3.4 Generality

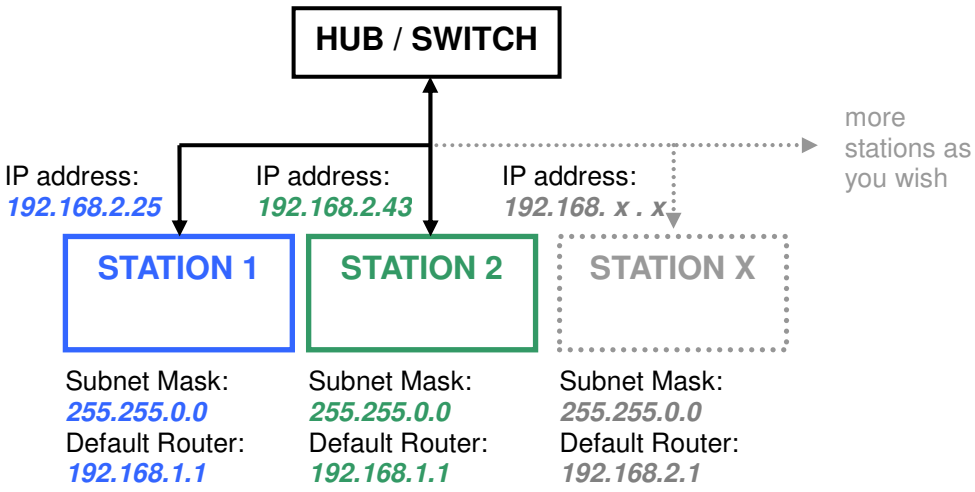
The **RFC 1918** is a recommendation indicating which IP settings you could use to build your own *private network/subnet*. This recommendation avoids your stations to communicate with unwished stranger stations which are present on other *private network/subnet*. These settings are frequently used (to see even always).

Otherwise it is not forbidden (**BUT NOT RECOMMENDED**) to use other similar IP Settings for your private network. You have just to be aware how the concept of the IP (Internet Protocol) works exactly according to the IP settings.

4 Communication within a subnet

When you know that the stations of your subnet **will not** communicate with stations of other foreign subnets, you can build your subnet either with a **HUB** or a **SWITCH.**

4.1 Network plan of a Subnet (private network)



4.2 Example

1) **STATION 1** wants to send data to **STATION 2**.

2) **STATION 1** knows the IP Address of **STATION 2.**

3) **STATION 1** check whether the Subnet Address of **STATION 2** corresponds to its Subnet Address (see below)

→ Subnet Address of **STATION 2 = 192.168.0.0**

192.168.0.0 = *192.168.2.43 (IP Address of STATION 2)*
"and bitwise" (see ch. 2.4)
255.255.0.0 (! *Subnet Mask of STATION 1*

→ Subnet Address of **STATION 1 = 192.168.0.0**:

192.168.0.0 = *192.168.2.25 (IP Address of STATION 1)*
"and bitwise" (see ch. 2.4)
255.255.0.0 (Subnet Mask of STATION 1)

4) The both station have the same Subnet Address. That means that **STATION 2** is in the same network (subnet) as **STATION 1.**

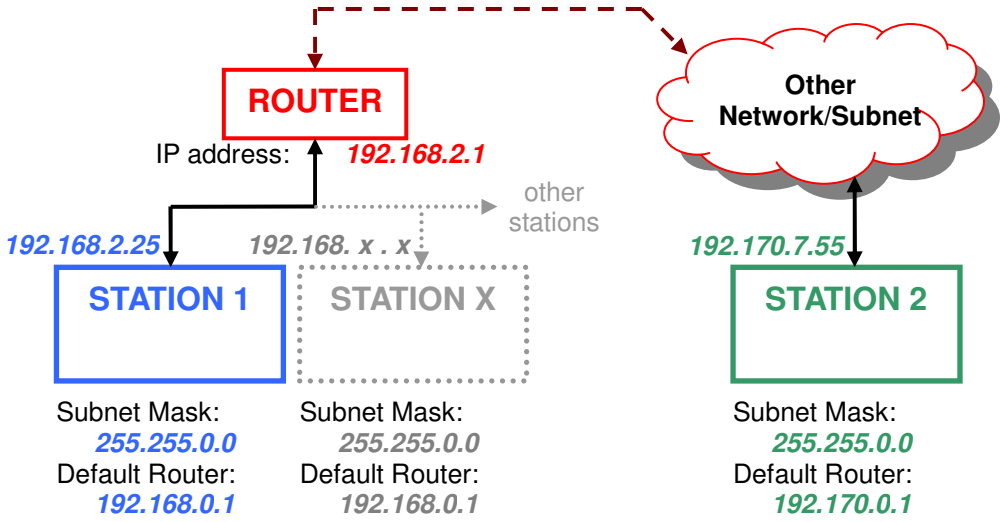
5) **STATION 1** send data on the subnet.

6) **STATION 2** receive the data.

5 Communication between different subnets

When you know that the stations of your subnet **will** communicate with stations of other subnets, you have to connect your subnet to other subnets using a **ROUTER.**

5.1 Network plan of interconnected subnets



As you can see (above), the STATION 2 is not in the same subnet as STATION 1.

How does STATION 1 know that??? How does it work??? See example below.

5.2 Example

1) **STATION 1** wants to send data to **STATION 2**.

2) **STATION 1** possesses the IP Address of **STATION 2.**

3) **STATION 1** check if its Subnet Address corresponds to the Subnet Address of **STATION 2**

→ Subnet Address of **STATION 1**:

192.168.0.0 = *192.168.2.25 (IP Address of STATION 1)*
"and bitwise" (see ch. 2.4)
255.255.0.0 (subnet mask of STATION 1)

→ Subnet Address of **STATION 2**:

192.170.0.0 = *192.170.7.55 (IP Address of STATION 2)*
"and bitwise" (see ch. 2.4)
255.255.0.0 (*Subnet Mask of STATION 1)*

4) The two stations have not the same Subnet Address. This means that **STATION 2** is not in the same network (subnet) as **STATION 1.**

5) **STATION 1** sends the data to the **ROUTER** (= Default Router → see chapter 2.3)

6) The **ROUTER** forwards the data to the other external network connected to ours through this same **ROUTEUR**.

7) This mechanism is repeated until the right network (that of the **STATION 2**) is found.

8) The **STATION 2** will receive the data.

6 Contact us

If you notice something wrong in this document let it us know.

For further information you can ask us per mail or per telephone.

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