Industrial Intelligent Gateway
Application Notes

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1 Objective

The objective of this document is guide how to use our industrial intelligent gateway product. We provide three amazing application solutions:
Remote Access: we provide a cost-effective solution for remote access your PLC
SMS management: the powerful bi-directional SMS function, to truly achieve M2M communication via SMS.
Remote Monitor: we provide a web-based monitoring solution for remote monitoring the real-time status of your field equipment.
The document contains detailed steps required to help you easy deploy application solution.
2 Terms and definitions

InHand Device Cloud:
InHand Device Cloud, or call Device Network Cloud is cloud-based M2M platform especially designed for remote device centralized management and data aggregation. InHand Device Cloud contains three parts: Device Manager, Device Touch and Device Sense.

Device Manager:
A cloud-based management platform for remote managing your InHand cellular device, such as IG601.

Device Touch:
A cost-effective remote access service

Device Sense:
A web-based platform for remote monitoring your equipment

Device Touch client:
Device Touch client is the client software installed on the user's computer for establishing a secure channel between engineer station and field gateway

Equipment:
Equipment is the machine that required maintaining or monitoring.

Device Models:
This is a relevant parameter with Device Manager. It contains Ethernet equipment, serial port equipment and other specific PLC model that you added.
3 Remote Access to your PLC

InGateway provide a cost-effective solution for remote access PLC. Cooperating with InHand Device Touch service, you can easy establish a secure channel between engineer station and field InGateway to achieve remote programming, diagnosis, and commissioning of your PLC.

3.1 Precondition

Before using this solution, please confirm with the following conditions
A, you have got a legitimate Device Manager account. Your account should have the Device Touch service permission. Please refer to section 3.3.2
B, you need apply Device Touch client. Please refer to section 3.4.1
C, you have got an InHand industrial intelligent gateway, such as IG601.
D, you have got an available SIM card
E, the needed connected PLC, PLC communication cable and the PLC programming software
F, A configuration PC which can access Internet
3.2 Make InGateway Connect Internet

3.2.1 Hardware Connection

- Install the antenna, power supply and insert SIM card.
- Link your configuration PC to InGateway’s Ethernet port using a crossed cable.

More detailed hardware installation, please refer to “User’s manual IG601”

3.2.2 Configure InGateway for Internet connection

Login your InGateway via Web interface, the default IP address: 192.168.2.1, set your configuration PC IP address in the same subnet with InGateway; and the default username/password is adm/123456. From the navigation panel, select Network >> Dialup, then enter “Dialup” page, as shown below.

![InGateway Dialup Configuration](image)

- **Enable**: Check the box
- **Time schedule**: ALL ▼ Schedule Management
- **SHARED**: Check the box
- **Network Provider (ISP)**: Custom ▼ Manage
- **APN**: uninet
- **Access Number**: wG9++w1#
- **Username**: gprs
- **Password**: ⬅️three dots ⬅️
- **Network Select Type**: Auto ▼
- **Static IP**: □
- **Connection Mode**: Always Online ▼
- **Redial Interval**: 30 Seconds
- **Show Advanced Options**: □
APN: Please set the right APN, you can consult your local network operators.
Access Number: Usually use the default value “**99***1#” or “*99#”
Username/Password: Some APN need a username and password to do the PPP connection. But not every APN need them.
ICMP Detection Server: You can set an active address (e.g:8.8.8.) to make InGateway reconnect when lose network connection. This parameter can be shown when you enable “Show Advanced Options” The other parameters you can keep the default value.

### 3.3 Add your InGateway and PLC to Device Manager

#### 3.3.1 Configure InGateway to connect Device Manager

From the navigation panel, select **Services >> Device Manager**, then enter “**Device Manager**” page, as shown below.
3.3.2 Add your InGateway to Device Manager

**Step 1: Register your account**
You can register your account through our Device Manager platform: [http://g.inhandnetworks.com](http://g.inhandnetworks.com)
We provide super administration account for enterprise customer. You can also apply a Device Manager account from our technical support: support@inhandnetworks.com

**Step 2: Add your device**
After got you account, accessing the Device Manager platform and start to add your device.
In the “Site List”, click “Add Site” to add a site (InGateway). Please set the InGateway information as the picture below:
ID: the Device ID of InGateway, you can know this ID from the “Device Manager” of InGateway configuration interface.
Site Name: you can name the device yourself.
Gateway Model: Select the "IR6XX_WCDMA".
Region Name: Select your location.

3~5 minutes later, you can see your InGateway is online (green tick in the action column) and you can remote configure or do other operate through Device Manager.

### 3.3.3 Add your PLC to Device Manager

**Step 1: Add PLC Device**
Click online site and choose “Sit” to enter “Site Management”.

Click the “Site” and choose “Field Device Management” to add Field Device
Click “Add Field Device” to add your PLC.

Device Name: you can name the device yourself.
Device Model: choose “General Ethernet Equipment” or “General Serial Port Equipment”.
IP Address: If you add a Ethernet PLC, you can set the PLC IP address here.
Notice: If you account enjoy the Device Sense service permissions, the “Add Field Device” Web page should have more configuration parameters for configuring PLC.

After added succeed, click “Save Settings”, and then you will see Device in the list.
3.4 Remote access your PLC

3.4.1 Download and install Device Touch client

Login your Device Manager account (g.inhandnetworks.com) and access the homepage, Click “Download->Secure Access Client”, then install client software.

![Device Touch Client login page](image)

After the installation, Device Touch Client will be showed.

![Device Touch Client connection](image)

Your PC operating system should be one of the following

- Windows XP home/professional 32bit
- Windows 7 home/professional 32bit/64bit

These operating systems have been tested to support the Device Touch software, other versions of Windows, please contact our technical support.

3.4.2 Establish remote access tunnel

After added your InGateway succeed, open Device Touch Client, input your Device Manager account and login to establish tunnel between your PC and Device Touch cloud.
Then, you will see your online InGateway in the list. Click “Connect” to establish tunnel between InGateway and Device Touch cloud.

Now, your PC can remote access your InGateway through Device Touch cloud. Please see the connection diagram below:

After tunnel established, you can see a virtual port (COM3) is generated.
3.4.3 Link InGateway and PLC

You can link locally PLC to InGateway with serial port or Ethernet port. If you have an Ethernet PLC, you need link directly PLC to Ethernet port of InGateway using an Ethernet cable, and set the InGateway` LAN address as your PLC gateway.

If you have a serial PLC, link the serial PLC to InGateway’s serial communication terminal. Login your InGateway configuration web-interface, Select the right serial mode (RS232 OR 485) and configure the right serial parameter that compatible with your serial PLC.

3.4.4 Remote access PLC

- If you have linked an Ethernet PLC to InGateway
  Once the access tunnel established, you can run you PLC programming software or access Web server to remote access your PLC via the PLC local IP address.
- If you have linked a serial PLC to InGateway
  Once the access tunnel established, you set your PLC programming software reading the generated Virtual COM port to remote download/upload program.

3.5 Remote PLC upload program example

Now, take AB RSLinx Classic as example, PLC link to InGateway via serial port. Open AB RSLinx Classic software, make virtual dial connection. If the connection established, you will see a PLC icon.
1. Click “configure drivers”

1. Running RSLinx Classic, Set up communication interface

1. Select “RS232 DF1 devices”

2. Click “ADD”

2. Click “OK”

1. Fill in interface name

1. Right-click on “AB DF1-2”, select configure Driver
1. Select Virtual Serial COM3
2. Select the PLC CPU models
3. Click “Auto-Configure” PLC CPU models
4. Click “OK”

1. Click “communication—who Active”

1. Click “UPDATE”

1. You can use the “ALL” button
1. Click "GO-ONLINE".

2. Select upload process.

3. Update process.
4 Easy manage your PLC via SMS

InGateway provide powerful bi-directional SMS function, it’s possible to monitoring and control your PLC using SMS without establishing a secure tunnel to the Device Touch cloud.

The SMS function contains three parts:

- **SMS Alarm**: when the exception occurred, users can receive timely alarm SMS.
- **SMS query and control**: Mobile users can remote monitor and control the field PLC via SMS.
- **InGateway support not only the communication between PLC and mobile user, but also the communication between PLC and PLC to truly achieve M2M communication.**

When you use SMS function, please stop your Device Touch service.

**4.1 Precondition**

Before using SMS function, please confirm with the following conditions

A, your InGateway have accessed to Internet, please refer to section 3.2

B, you have got a available SIM card with enabling SMS service

C, The PLC supports Modbus protocol with RS232/RS485 serial interface

D, PLC programming software

**4.2 Link PLC to InGateway**

InGateway provide two serial interface modes - RS232 and RS485.

When installing, remove the terminal from the device, loosen the locking screw on the
terminal, and insert the corresponding cable into the terminal and then tighten the screw. The terminal interface description as the picture below:

![terminal_interface]

According to your PLC serial type, link the right interface (RS232/RS485) of serial communication terminal.

4.3 Mudbus Map

Before add your PLC and the corresponding variables to InGateway, you need check locally your PLC current variables and map the PLC variable to modbus address via programming software. Plan the Modbus address of variables and its type for adding to InGateway.

4.4 Add Modbus PLC to InGateway

InGateway inquires the variables status of the PLC every ten seconds and saves them into RAM. These variables will be the SMS response sent after a query. After receiving a control SMS, InGateway sends the control command to the PLC and waits for a response. The response is sent from the PLC and then InGateway sends the response to the user.

4.4.1 Configure serial parameters

Link your configuration PC to InGateway’s Ethernet port using a crossed cable and login InGateway via Web interface. From the navigation panel, select System >> Serial Port, then enter “Serial Port” page, as shown below.
In order to keep the communication normally, the configured serial parameters should be consistent with the PLC’s serial port parameters.

### 4.4.2 Add PLC to InGateway

Follow the five steps below to configure PLC parameters:

**Step 1:** From the navigation panel, select “Services” >> “Modbus to SMS” to enter into “Modbus to SMS” page.

**Step 2:** Enter the “PLC List” sub-menu. Select each PLC to be used, and configure them one by one. Up to eight PLCs can be added. If you use RS232 interface PLC, you can only add one PLC here.
Step 3: Configure the specific parameters of PLC, each PLC can be added to 32 variables.

1) Set the modbus type. Only RTU is available on this model.

2) Configure the slave address of each PLC, namely the ‘Modbus ID.’ It may be assigned a value from 1 to 247.

3) Configure name of the PLC, using a maximal length of 16 bytes. It is important to name PLCs to avoid confusion in a large scale operation.

4) Enter the register address, or modbus variable address, in the first column. 0xxxxx is for discrete inputs. 1xxxxx is for a coil. 3xxxxx is for the incoming register, and 4xxxxx indicates a holding register.

5) The second column is the variable type, supporting BIT, WORD, DWORD, FLOAT, INT16, INT32 and INT64.

6) In the third column are the units of variable with maximum length of 8 bytes. This value will appear in SMS, and you can leave this field empty. The unit of BIT variables should be configured according to HH/LL format, HH represents the corresponding unit of “1,” LL represents the corresponding unit of “0.” The units of other types of variables will appear directly in SMS.

7) Enter the register name in the fourth column. This is simply the name of the variable with a maximum length of eight bytes. Users can define names for each variable and
this field must be filled. The variable address will be replaced by variable name in SMS.

Instruction

- PLC name can’t repeat in InGateway.
- Variable names (Register name) can be repeated in one PLC variable list.
- Each PLC should be defined with ID, name and at least one variable.

Step 4: Repeat step 3 and add more PLCs.

Step 5: Click <Apply> button, store and apply the new configuration.

4.4.3 Read the added variables locally

After added PLC and corresponding variables, you need read the added variable locally and check whether the hardware connection is connected correctly between PLC and InGateway.

From navigation panel, select Status >> Modbus PLC, then enter “Modbus PLC” page, as shown below. This page can show all the PLC connection status, and the current values of all variables.

Notice: At this time, you should make sure your PLC linking to InGateway correctly.

4.5 SMS alarm rule

InGateWay supports the configuration of up to one-hundred alarm rules, that when triggered send an alarm message to user’s mobile phone. User can set the alarm rules, and adjust the SMS receiver in the alarm menu. InGateWay will collect different variables depending on the alarm rules set by the user. When a variable matches the criteria, InGateWay will send an SMS alarm to all users on the “alarm user list,” along with a message.
4.5.1 Add alarm rule

From the navigation panel, select Services >> SMS Alarm Rules, then enter “SMS Alarm Rules” page, as shown below.

![Alarm rule list](image)

In this section of interface, the technician will create an "alarm rule list." Each line defines an alarm rule and a maximum of one-hundred alarm rules can be configured. The technician will match mathematical expressions and compare values to a variable in each rule. To set an alarm rule follow these steps:

- Select a PLC in the first column. Any PLC previously setup in the “Modbus to SMS” chapter of this manual will appear in a drop-down menu.
- Select a variable name in the second column, and the corresponding variable of the PLC will appear above it. The technician will compare values to this variable.
- Compare the variable to a value by selecting an operator in the third column. The available options are: NONE, >, >=, <, <=, = and !=.
- Define the first value in the fourth column. This value will be compared to the main variable. For example, temperature >= 200 means that when the temperature is greater than or equal to 200, an alarm will be sent.
- Define the relationship between the first expression and the second expression in the fifth column by selecting OR, AND or XOR.
- Select a second operator in the sixth column. The options that can be selected are: NONE, >, >=, <, <=, = and !=.
- Define a second value in the seventh column.
- In the eighth column, the user must define a dead zone, which acts as a buffer. After the alarm is trigger, it will not be sent until the variable exceeds the dead zone value. It is only effective for numerical, non bit-wise values. Set the value to zero to eliminate the dead zone.
- In the ninth column titled “ACTION?,” users may select “YES” to enable user-defined alarm messages. Otherwise, the default alarm message will be sent. The maximum length for a short message is 140 bytes.
- The mobile phone number of a recipient is input in the tenth column.
- A user-defined alarm message may be set in the eleventh column. When triggered, this message will be sent in the form of an SMS. The alarm SMS are divided into two types:
  1) Defaulted alarm short message. If the selection for “ACTION?” in the ninth column is NO, the system will send the automatically generated defaulted alarm short message. The message will be defined by the variable, for example: “Alarm plc2 OUPUT=on,” or “Alarm plc AB_VOLT=238V.”
  2) User-defined alarm short message. If the selection of “ACTION?” is YES, the system will send a user-defined alarm.
Below is an example of an alarm rule:

The first rule states that when the OUTPUT1 of plc2 changes from 1 to 0 or from 0 to 1, trigger the alarm and send the alarm SMS to all users in the “alarm user list.”

The second rule states that when the variable value of AB_VOLT in plc2 is less than or equal to 20 or greater than or equal to 230, trigger the alarm and send the user-define SMS to the user ‘13810556243.’ In other words, when AB_VOLT is between 20 and 230, plc2 is in normal operating conditions.

4.5.2 Add alarm list

When alarm happened, the alarm message will be sent to users added in this list.

- Up to ten alarm recipients can be added to the “alarm user list.”
- Mobile phone numbers are filled in the first column, and may range from 1 to 16 bytes long. This column must be filled, otherwise users cannot be added.
- User names are filled in the second column, and may range from 0 to 16 bytes long. This column may be left empty.
- Telephone numbers should be non-duplicated.

4.5.3 Add white list

InGateway is capable of receiving a control and inquiry SMS from any user. In order to improve security, users can enable the white list function. After the white list is set, InGateway only processes SMS from users on the white list, meaning any other SMS will be dropped. If it’s disabled, then InGateway will process SMS from any phone number.
● Up to 10 users may be whitelisted.
● The first column is a telephone number, with a length ranging from 1 to 16 bytes, and is mandatory.
● The second column is the user name, with a length ranging from 0 to 16 bytes, and is optional.

After enabling the “Modbus to SMS” function, InGateway can identify two types of SMS commands sent by the users on the white list. InGateway performs an action corresponding to different commands and then sends a response to the SMS user.

### 4.6 SMS query and control

After enable “Modbus to SMS” function, InGateway can identify two types of SMS commands sent by the users on the white list. After receiving SMS, InGateway perform the corresponding operation according to different commands and then sends response SMS to user.

The following shows the two type format of the SMS and the response message.

1) **The SMS to inquire state**

Users can edit the following SMS to query IG601 operating status and the register value of PLC.

<table>
<thead>
<tr>
<th>Request</th>
<th>Response Message</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>plc1 connected plc2 disconnected</td>
<td>Inquire about the name and status of all PLCs connected to the IG601.</td>
</tr>
<tr>
<td>GET plc1_name, plc2_name...</td>
<td>plc1 OUTPUT1=on OUTPUT2=off plc2 OUTPUT3=on OUTPUT4=on</td>
<td>Inquire about the PLC variables with names of plc1_name, plc2_name. The plcX_names are parameter. Users can query different PLC variables by modifying the plcX_name. Different PLCs are separated by a comma.</td>
</tr>
<tr>
<td>GET plc1_name register1 register2, plc2_name register3 register4,...</td>
<td>Plc1 register1=5 register2=6 plc2 register3=1.8 register4=2.2</td>
<td>This command finds the value of a variables under a PLC named plcX_name. The plcX_name and registerX are parameters. Users can find the name of corresponding variables by</td>
</tr>
<tr>
<td>ALARM</td>
<td>Alarm total: 55, #53 date-time context1, #54 date-time context2, #55 date-time context3</td>
<td></td>
</tr>
<tr>
<td>ALARM 2-3</td>
<td>Alarm total: 55, #2 date-time context1, #3 date-time context2, #4 date-time context3</td>
<td></td>
</tr>
<tr>
<td>NETSATUS</td>
<td>Signal strength(dBm):xx, Network status: Registered to home network</td>
<td></td>
</tr>
<tr>
<td>MSGSTATUS</td>
<td>Received message: 10, Sent message: 15, Failed sent message: 0, Unauthorized message: 7</td>
<td></td>
</tr>
<tr>
<td>WHITELIST</td>
<td>WHITELIST ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

2) The SMS to perform actions

<table>
<thead>
<tr>
<th>Request</th>
<th>Response Message</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SET plc1_name register1=xxx register2=xxx , plc2_name register3=xxx register4=xxx…</td>
<td>Succeed: Set register1 to xxx set register2 to xxx set register3 to xxx set register4 to xxx</td>
<td>For a PLC named plc1_name, set the register value to xxx. The plcX_name and registerX are both parameters. User can set the corresponding variables by configuring these parameters in the command line. Such commands can set multiple variables synchronously. Different PLCs are separated by comma.</td>
</tr>
<tr>
<td>ALARM CLEAN ALL</td>
<td>Delete 1-55 alarm SUCCESS</td>
<td>Delete all the historical alarm records.</td>
</tr>
<tr>
<td>ALARM CLEAN xx-xx</td>
<td>Delete xx-xx alarm</td>
<td>Delete the historical records</td>
</tr>
</tbody>
</table>

trying different parameter commands. By entering multiple registers, multiple variables can be found at the same time. Different PLCs are separated by comma.

Find a count of historical alarm records and return the latest three historical alarms.

Inquire about historical records within the appointed number range. It can request maximum of five historical records each time.

Learn the network status.

Inquire about the SMS statistics.

Inquire about the startup status of the white list.
### 4.7 PLCs Communication via SMS

The PLCs can communicate with each other via SMS. For example, when 1 # PLC detects that the onsite temperature is too high, 1#PLC can send the alarm message to 2 # PLC with control command to let 2#PLC open the fan.

You need set the alarm rule on InGateway. Once PLC triggers the alarm, InGateway will send the command SMS to other PLC.

Follow the three steps below to configure PLC linkage:

**Step 1:** Login your 1#InGateway, set the alarm user as the SIM card number of 2#InGateway.

**Step 2:** On the alarm rule list of 1#InGateway, set the alarm rule as the picture below:

<table>
<thead>
<tr>
<th>PLC</th>
<th>Receiver</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2#InGateway</td>
<td>set test1=1</td>
</tr>
</tbody>
</table>

**Step 3:** On the 2#InGateway, add the SIM card number of 1#InGateway to the white list.

When the 1#InGateway detects the value of variable test is 0, this will trigger the alarm and send the alarm message to 2#InGateway. 2#InGateway receive the alarm message and find the context is a perform action command, 2#InGateway will perform the corresponding action. For example, the message context is “set test1=1”, then 2#InGateway will set the value of variable test under PLC1 as 1.
5 Remote monitoring your PLC

InGateway support data exchange functionality via Modbus RTU and support web-based monitoring platform to remote monitor the real-time status of your field PLC.
5.1 Precondition

Before using this solution, please confirm with the following conditions
A, you have got a legitimate Device Manager account. Please refer to the section 3.3.2. Your account should have the Device Sense service permission.
B, your InGateway have accessed to Internet, please refer to the section 3.2
C, you have add InGateway to Device Manager, please refer to the section 3.3.2
D, you have added Modbus PLC and the corresponding variables to InGateway, please refer to the section 4.4.2
E, a PC which can connect Internet
F, the PLC supports Modbus protocol with RS232/RS485 serial interface

5.2 Local check the variable values

We have omitted the steps how to add your PLC and the corresponding variables to InGateway, please refer to the section 4.4.2. Your Modbus PLC should be configured as Modbus slave and InGateway should be configured as master
From navigation panel, select Status >> Modbus PLC, then enter “Modbus PLC” page, as shown below. This page can show all the PLC connection status, and the current values of all variables.
5.3 Add Device Models to Device Manager

You can download a PLC variable template file which contains all the variables in the PLC you have added in section 4.4.2 “Modbus to SMS.” You need import the variable template file to Device Manager for adding the Device Models.

5.3.1 Download variable file

1. login you InGateway via Web, from the navigation panel, select **Services >> Mbsms Variable Template**, then enter “Mbsms Variable Template” page, as shown below.

2. Click the “Device x” to download the variable file to your PC.

3. Open the variable template (the default name is “var_template0”) to check the consistency with the added variable

   **Instruction**
   - Device1 to Device8 is corresponding to the PLC1 to PLC 8 you added.
   - When you add “Device Models” to Device Manager, you need import this variable template.
5.3.2 Import variable file

1. Login your Device Manager account (g.inhandnetworks.com), Click the “Device Models” to enter the Device Manager management page:

Click “Add” to configure device models

Model ID: Define the model ID (12345), it’s used for model management.
Model: Define the model name (test). You will select this model when you add your PLC to Device Manager.
Protocol: Select “Modbus RTU”.
Interface: Select “Serial port”.

After configured the device models parameters, import the variable file:
Select the right variable file, and click “Submit”:

Then you will see the added device model show on the model list below:

5.4 Add your PLC to Device Manager

Step 1: Add PLC Device
Click online site and choose “Sit” to enter “Site Management”.
Click the “Site” and choose “Field Device Management” to add Field Device

Click “Add Field Device” to add your PLC.

You can define your PLC name (demoPLC) and select the Device Models as you have added (test)
Device Name: Define your PLC name.
Device Model: Select the device model.
Device Address: Set your PLC modbus address.
After finished the basic configuration, click “Submit”, the added PLC will show on the device list as below. The default “Device ID” is “1”.

Click “Device ID” 1 to configure the PLC serial parameters

The parameter should be consistent with your PLC serial parameters and the serial port configuration on InGateway.
Set the right serial parameters and click the “Submit” to enter the “Field Device Management” page.

After enter the “Field Device Management”, Click “Save Settings” to save the configuration you have done.

5.5 Monitor your variables via Device Sense

Access the “Site View” page of Device Manager, Click your online InGateway and choose “Monitoring” to access “Site Management” page:
You will see the PLC you have added in the “Field Device List”

Click the PLC (demoPLC) you have added, then variables status of your PLC will show as below:

The field InGateway will update the PLC variables value to Device Sense cloud every one minute.
Here, you can remote monitor you PLC status at any time anywhere.