



RALINK TECHNOLOGY, CORP.

RT2870 Software Release Note for WinCE

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Product Name	RT2870 Wireless Adaptor
Interface Supported	USB
Install Package Version	P1.4.4.0B
Driver Version	V1.4.4.0B
Date	2009-7-14



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1. Introduction

This document guides you how to setup/integrate the Ralink RT2870 series driver in Windows CE operating system.

2. Hardware Requirements

The adapters (made with the Ralink RT2870 series chipset) are supported as below:

1. Ralink RT2070
2. Ralink RT2870
3. Ralink RT3070
4. Ralink RT3071
5. Ralink RT3072

3. Software Requirements

1. Platform Builder 5.0 or
2. VS2005+Windows CE 6.0(or higher)
3. Windows CE 5.0 QFE20061231 is necessary. The WPA2 is supported after this QEF.
4. The driver package is included four type of the CPU(X86, ARM, MIPS and SH4).

The major files description as below:

- RT2870.DLL (binary of driver)
- RT2870.BIB (Sample BIB file)
- RT2870.REG (Sample REG file)
- RT2870.xxx.CAB (install package. xxx is CPU name, e.g. x86)



4. Wireless Features

The Ralink wireless features are divided in two parts: Station mode and AP mode

- Infrastructure(Station mode)
 - i. Open/None
 - ii. Open,Shared/WEP
 - iii. WPA-PSK/TKIP,AES
 - iv. WPA2-PSK/TKIP,AES⁽ⁱ⁾
 - v. WPA/TKIP,AES
 - vi. WPA2/TKIP,AES⁽ⁱ⁾
- Adhoc(Station mode)
 - i. Open/None
 - ii. Open /WEP
 - iii. WPA-None/TKIP, AES
- WPS Enrollee(Station mode)
 - i. PIN
 - ii. PBC
- DLS(Station mode)
 - i. Same as infrastructure mode
- AP Mode
 - i. Open/None
 - ii. Open,Shared/WEP
 - iii. WPA-PSK/TKIP,AES
 - iv. WPA2-PSK/TKIP,AES

Note:

(i). It is necessary to support WPA2 security in Windows CE 5.0, the QFE 2006 must be installed.

(ii). When driver in AP mode, WZC must be disabled. The ratool is applied to configure the wireless parameters.

(iii). Some wireless parameters for the stations can not be set within WZC, the ratool is required to configure them.



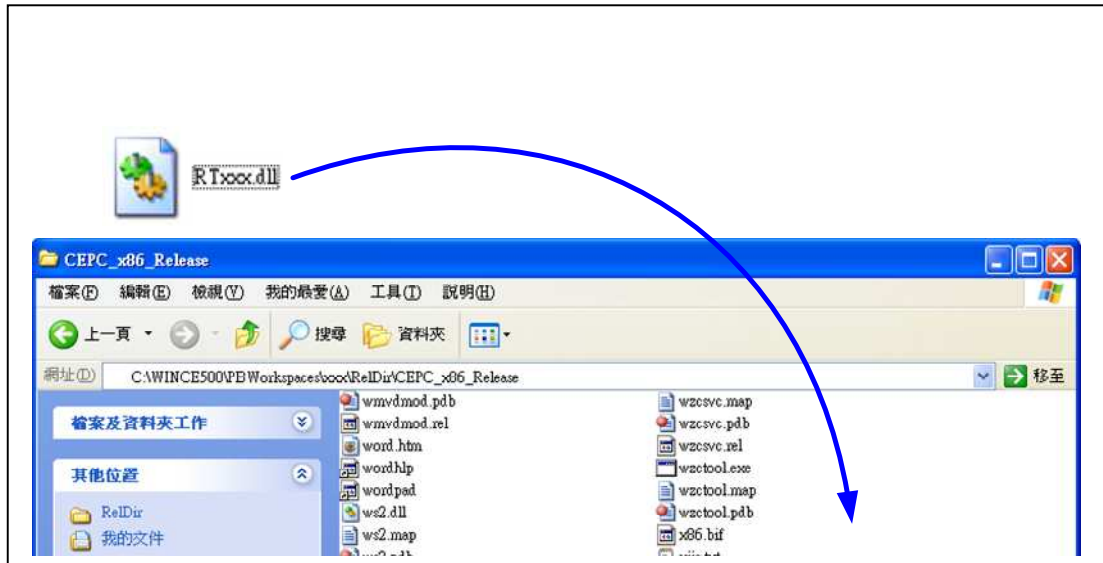
5. Driver Integration Instructions

Here are the major steps to integrate into your Windows CE system.

5.1 Integration

1. Put RTxxx.DLL(driver binary file) in your

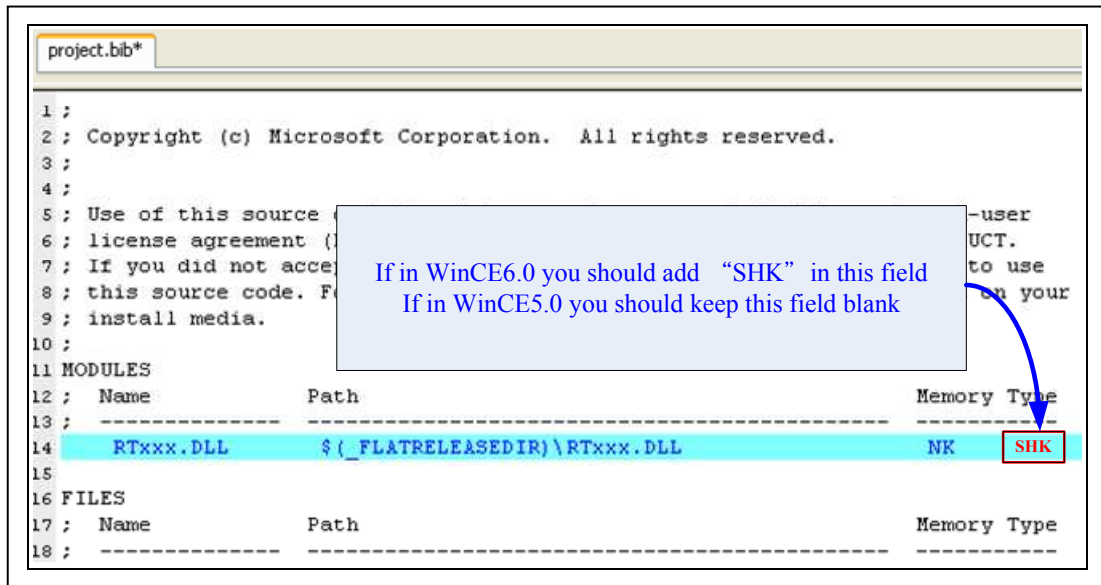
_WINCEROOT⁽¹⁾\PROJECT\XXXXX\RelDir\<release_directory>⁽²⁾



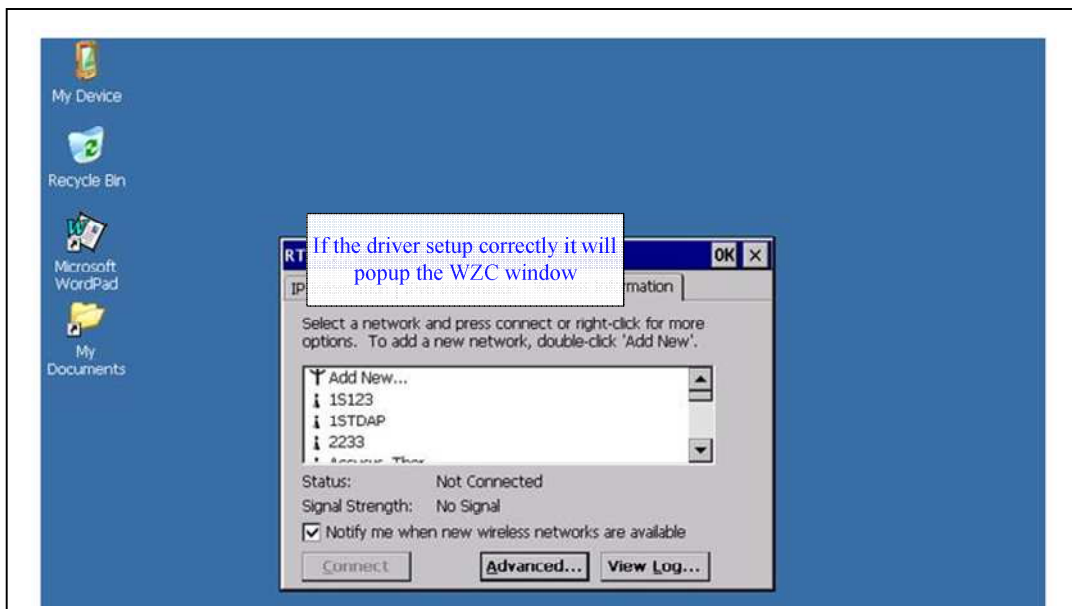
(1). _WINCEROOT as "WINCE500" or "WINCE600" depends on your OS.

(2). <release_directory> is BSP solution configuration related ex. CEPC x86 release mode default is: CEPC_x86_Release.

2. Add RTxxx.BIB and RTxxx.REG into your PROJECT.REG and PLATFORM.BIB files. Don't change the BIB file if you are not familiar with the image generation settings.



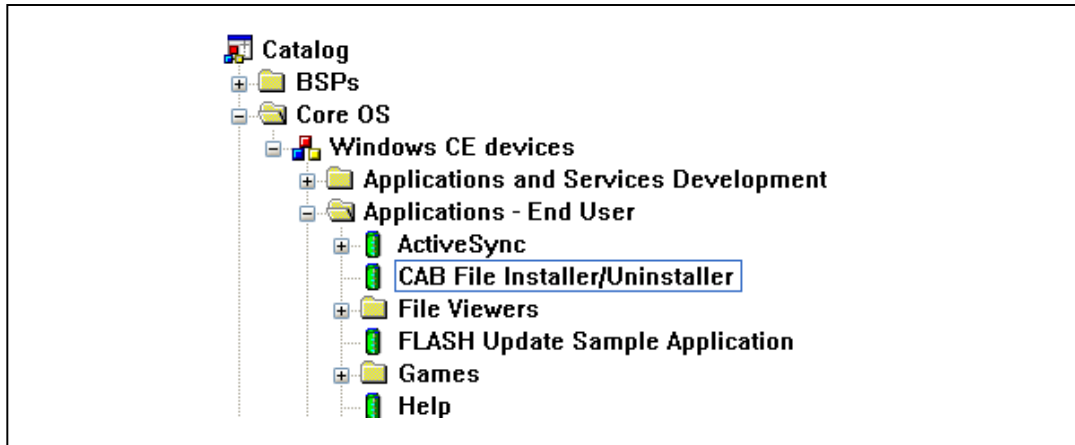
3. Make sure your device PCI Device ID or USB VID/PID.
4. Change registry file if you want to change driver the default driver parameters. In general, you don't need to change those parameters.
5. Rebuild your image and download to your platform.
6. After system booting up, WZC Autoconfig windows will pop up on screen(Station mode)



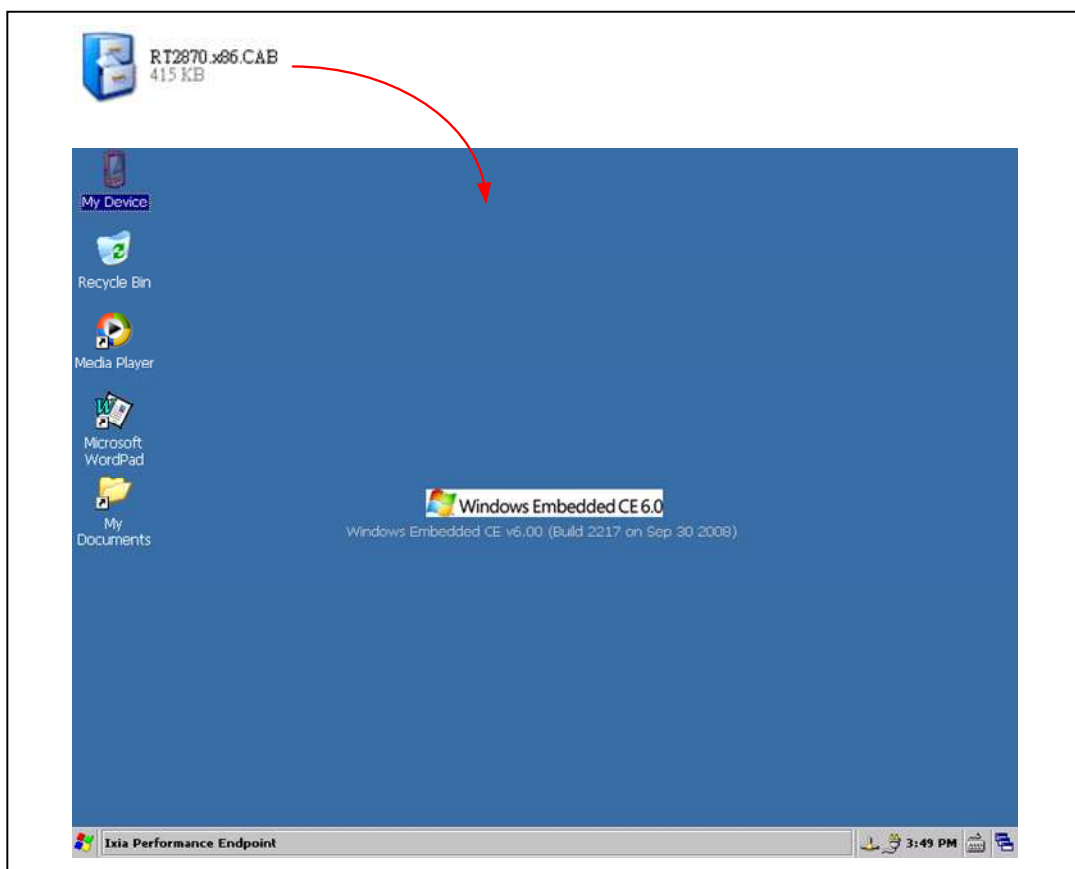


5.2 Install by using CAB file

1. CAB catalog should be included in your BSP



2. Copy CAB file to your platform

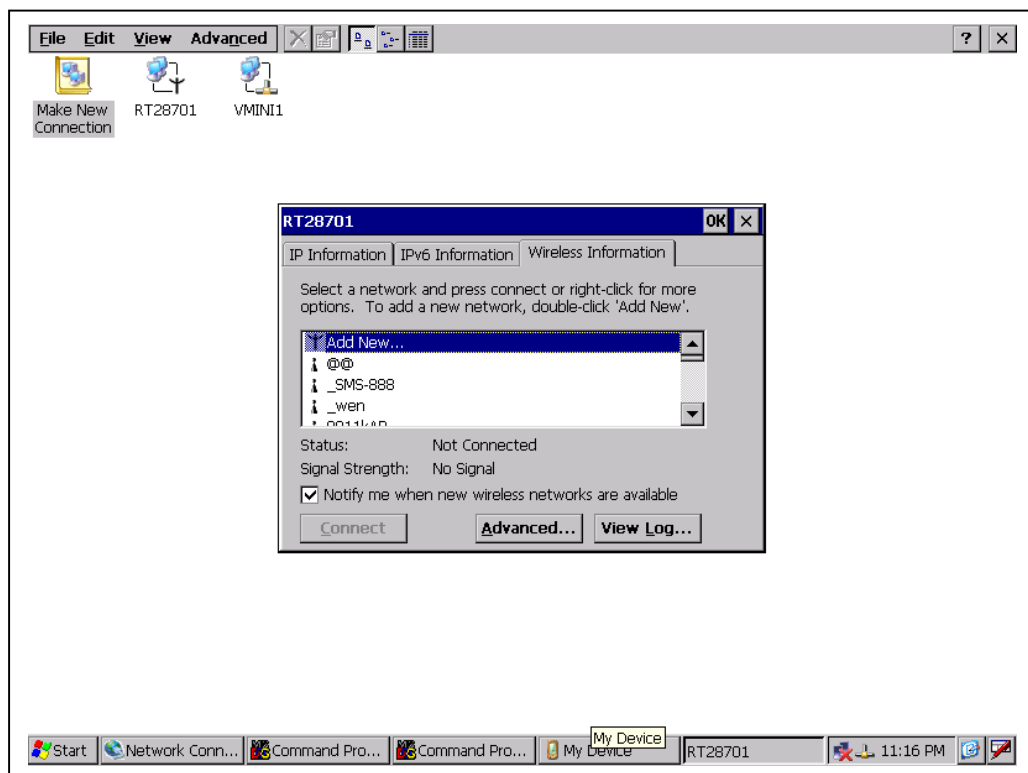




3. Double click the CAB file on your platform, and press OK to install on Windows directory.



4. Plug your device, WZC Autoconfig windows will pop up on screen(Station mode)





6. Registry Setting Descriptions

1. In general, you don't need to change the default registry setting for Windows CE OS

```
[HKEY_LOCAL_MACHINE\Comm\RT2870]

    "DisplayName"="RT2870 b/g/n Wireless LAN Driver"
    "Group"="NDIS"
    "ImagePath"="RT2870.dll"

[HKEY_LOCAL_MACHINE\Drivers\USB\LoadClients\Default\Default\Default\
RT2870]

    "Dll"="RT2870.DLL"

[HKEY_LOCAL_MACHINE\Drivers\USB\ClientDrivers\RT2870]

    "Dll"="RT2870.DLL"
;
;Add this if hive-based registry is enabled(i)
; "Flags"=dword:1000
```

Note:

(i). If your system is hive-based registry, you need to removed the comment.



2. Common Registry Setting for Station and AP Mode:

[HKEY_LOCAL_MACHINE\Comm\RT28701\Parms]

```
"BusNumber"=dword:0
"BusType"=dword:0
"OpMode"=dword:0
"WirelessMode"=dword:5
"Channel"=dword:1
"CountryRegion"=dword:5
"Encryption"=dword:0
"AuthenType"=dword:0
"ShowHiddenSSID"=dword:0
"AutoReconnect"=dword:1
"NetworkType"=dword:1
"SSID"="RT2870AP"
"BGProtection"=dword:0
"AdhocOfdm"=dword:2
"AdhocNMode"=dword:1
"ProviderName"="Ralink Technology, Inc."
"VendorDesc"="RT2870 802.11 b/g Wireless Card."
```

[HKEY_LOCAL_MACHINE\Comm\RT28701\Parms\TcpIp]

```
"EnableDHCP"=dword:1
"DefaultGateway"=multi_sz:"192.168.2.254"
"IpAddress"=multi_sz:"192.168.2.234"
"Subnetmask"=multi_sz:"255.255.255.0"
"DNS"=" "
"WINS"=" "
```

Note:

- (i). Rebuild the image and load on the platform.
- (ii). After system boot, the driver will be loaded.
- (iii). You can change the "EnableDHCP" to 0, if you want to use static IP.



3. AP Mode Registry Setting Example for initial system booting:

```
[HKEY_LOCAL_MACHINE\Comm\RT28701\Parms]

"OpMode"=dword:1          ; AP mode=1, Station mode=0
"Channel"=dword:1         ; 1~14
"SSID"="RalinkAP-WinCE"   ; Max 32 ASCII Chars
"AuthenType"=dword:0
;      0: OPEN, 1: SHARED, 4: WPAP-PSK, 7: WPA2-PSK
"Encryption"=dword:1
;      1: NONE, 0: WEP, 4: TKIP, 6: AES
"WEPKeyUse"=dword:2       ; 1~4
;      Must be 2 if your AuthType is wpa-psk or wpa2-psk
"WEPKey1"="12345ABCDE"
;      10-char hexadecimal for WEP40
"WEPKey2"="QWERT"
;      5-char ascii for WEP40
"WEPKey3"="1234567890ABCDEFABCDEF1234"
;      26-char hexadecimal for WEP128
"WEPKey4"="ABCDEFGHIJKLM"
;      13-char ascii for WEP128
;
;      WEP KEY, 5-char ascii or 10-char hexadecimal for WEP40
;      13-char ascii or 26-char hexadecimal for WEP128

"WPAPSK"="432985e9d4167362a98f3598f17285dd23f8403171f679c2bece83c
6c78b34c9"
;      WPA-PSK or WPA2-PSK's 64-char hexadecimal PMK only
```

Note:

- (i). Rebuild the image and make sure the registry file has been built-in nk.bin file.
- (ii). When system is booting, the driver will be loaded and the driver-related registry section will be loaded by driver when driver initializing.
- (iii). The WZC auto-configure utility in default Windows CE shell for wireless configuring must be disabled when the wireless driver is working in AP mode.
- (iv). The Authentication and Encryption Combinations of AP mode as below:



OPEN/NONE

OPEN/WEP

SHARED/WEP

WPA-PSK/TKIP

WPA-PSK/AES

WPA2-PSK/TKIP

WPA2-PSK/AES

(v). A pass phrase is needed to use wpa_passphrase.exe to generate the PMK in registry. The program can be requested from our FAE.

(vi). Internet Connection Sharing(ICS) in Windows CE can be enabled for AP mode. Details can be found in help file or on the MSDN.

(vii). We strongly recommend you can use RATOOL to change the AP parameters.

(viii). The system is rebooted or the driver is reloaded, the registry setting will be take effect if any the registry is changed.



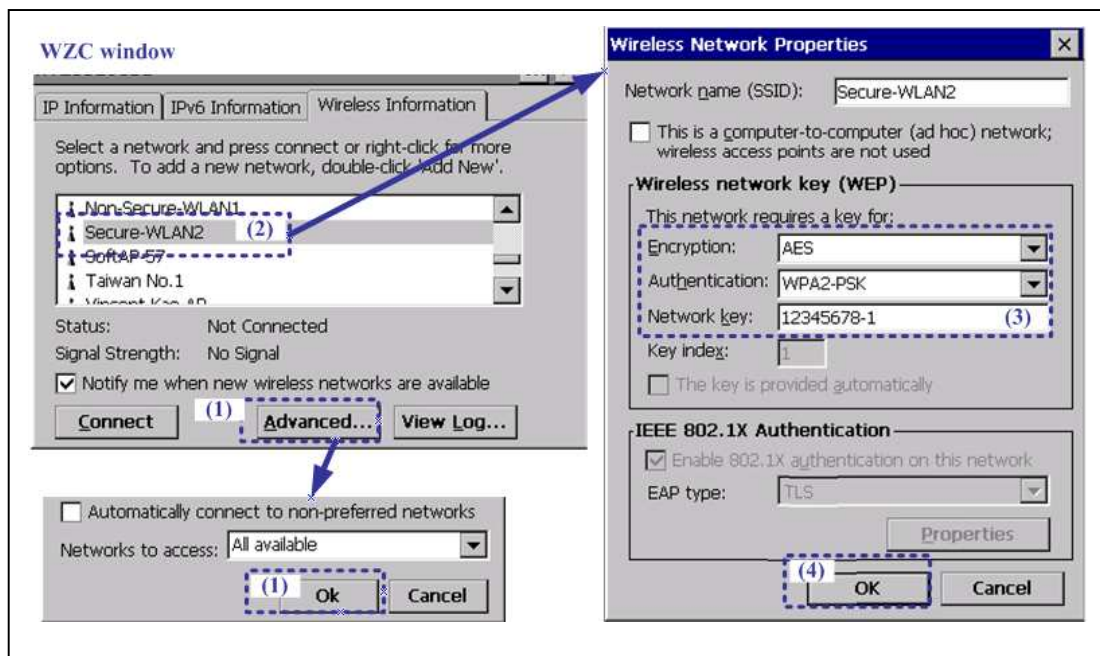
7. Configuration

Ratool is a wireless command line utility running in Windows CE command shell. The source of the Ratool is from wzctool and adds more proprietary Ralink OID functions. The user can make use of this tool to modify the Ralink wireless driver details and settings.

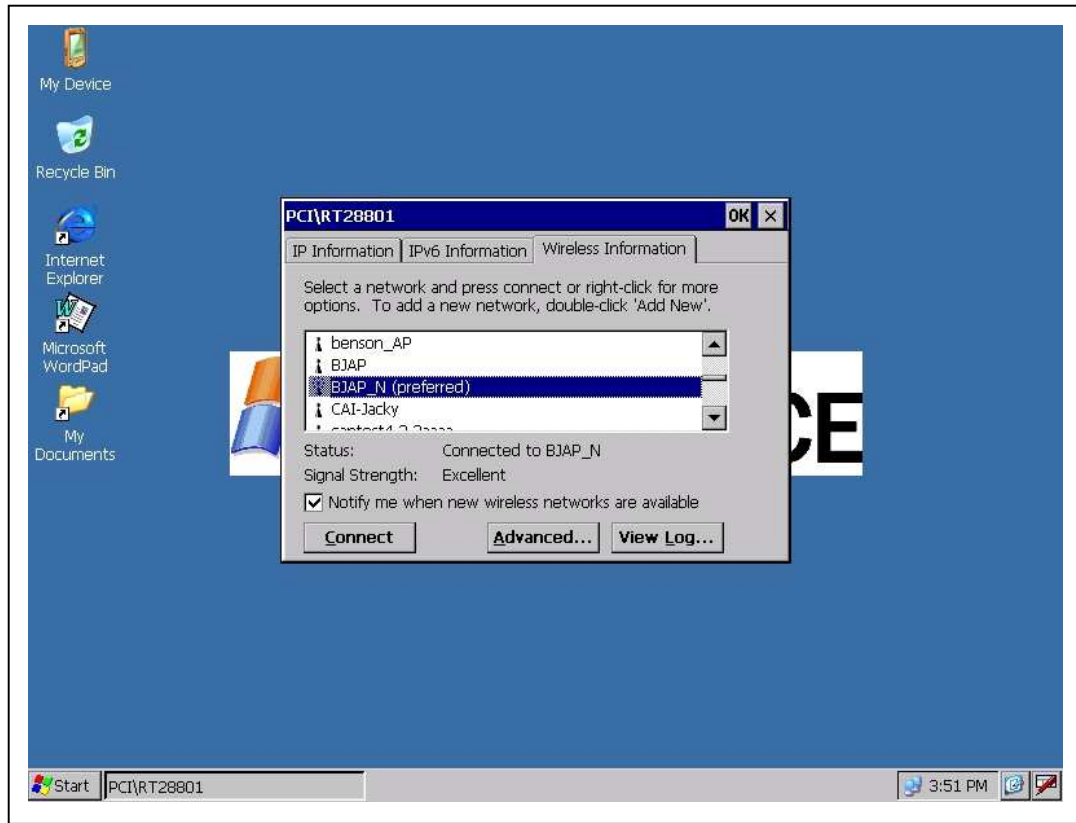
The ratool source code is available. Please contact our sale representative in your region(some NDA/SLA must be signed).

7.1 Station mode – Infrastructure

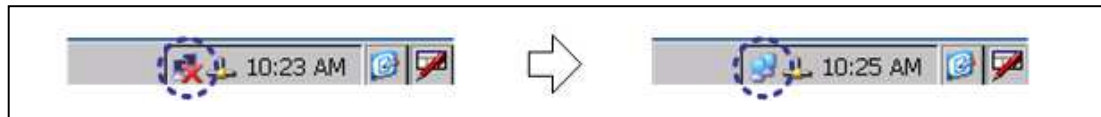
To configure wireless station connecting an AP, you can use WZC to do it directly.



- (1). List all available APs around your station. To rescan available network, you need to click "Advanced" button, WZC will pop up "Advanced Wireless Settings" window, and then click OK on this window.
- (2). Click a desired AP(SSID), WZC will pop up "Wireless Network Properties" window.
- (3). You must input proper Authentication, Encryption and Key for your specific AP.
- (4). When all inputs are done, click "OK" button to connect the desired AP.



(4). When successful connected, you can see the Status will display “Connected to SSID_AP”.



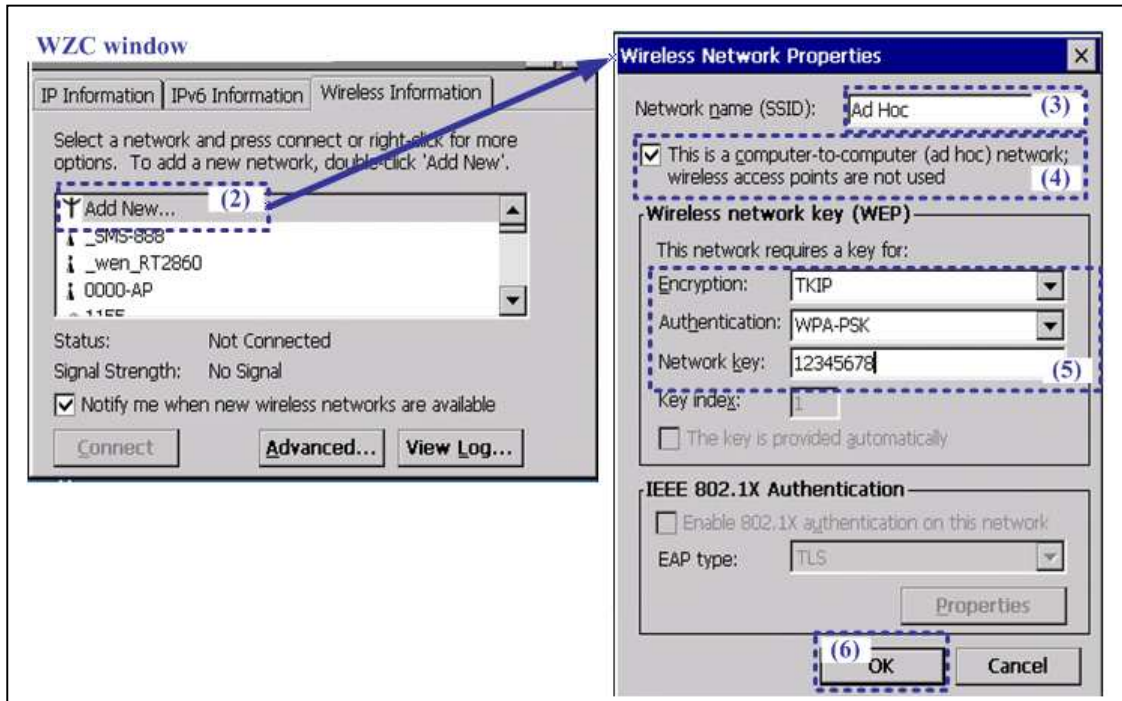
(5).The red “X” of the network icon in the system tray on the bottom right of the desktop shell is disappeared.



7.2 Station mode – Adhoc

There are two cases in Adhoc network: (1) As a Creator in an AdHoc network or (2). As a Joiner.

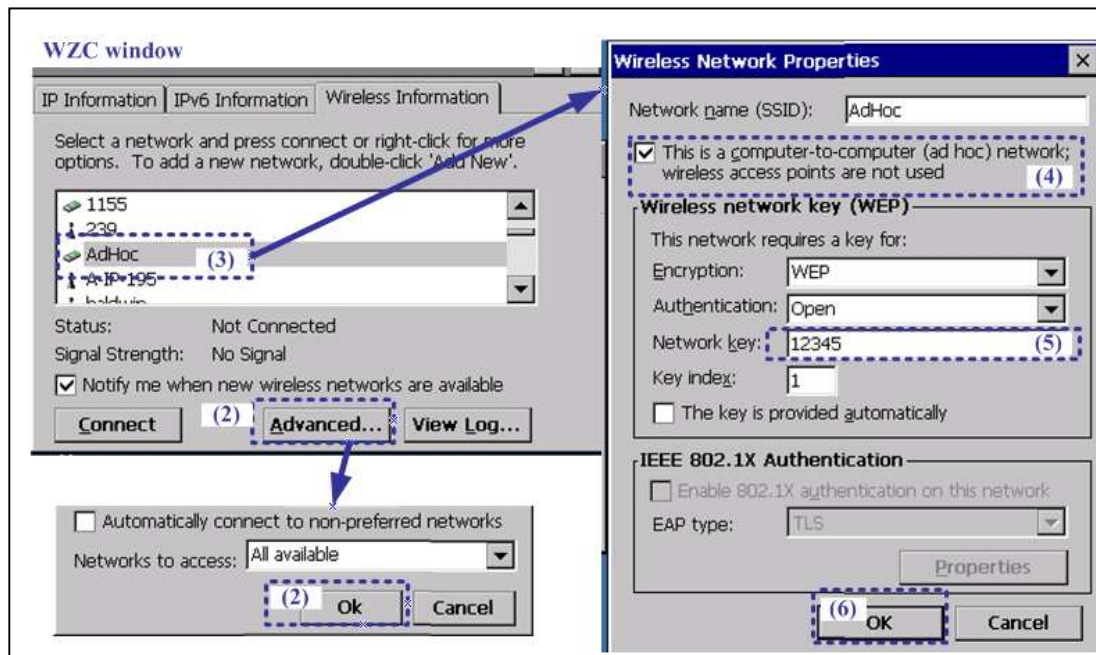
I. Creator(Create a new AdHoc network)



- (1). As a Creator, create a new AdHoc network.
- (2). Click "Add new"
- (3). "Wireless Network Properties" window is pop up. Specify your desired name of AdHoc network.
- (4). Check the check box of the AdHoc network
- (5). Input your desired AdHoc network properties (Authentication, Encryption and keys).
- (6). Click "OK"
- (7). Wait for another AdHoc station to join this network.



II. Joiner(Join another AdHoc network)



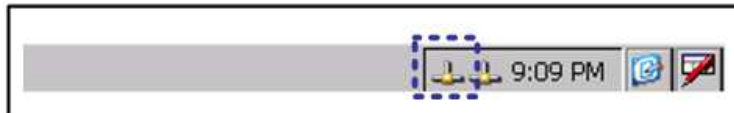
- (1). As a Joiner, join an existed AdHoc network.
- (2). List all available networks around your station. To scan available networks, you need to click "Advanced" button, WZC will pop up "Advanced Wireless Settings" window and then click "OK" button.
- (3). Click a desired AdHoc network, WZC will pop up "Wireless Network Properties" window. The leading icon looks like a "card".
- (4). Checked the check box of the AdHoc network
- (5). Input the desired AdHoc network properties(Key).
- (6). Click "OK"
- (7). Connect to desired AdHoc network.



7.3 AP mode

To configure wireless module as an AP, You must set "OpMode" to 1 in registry. Then, you can use registry or ratool to configure network parameters of AP. The method of registry has described in previous section. This section will describe how to use ratool to configure parameters of AP.

In AP mode, the WZC will be disabled. The network icon in the system will different from station mode. The network icon looks like normal Ethernet network icon.



The following examples describes how to configure network parameters of the AP mode

1. OPEN/NONE

```
> ratool -ap <CARD NAME> -auth open
> ratool -ap <CARD NAME> -encr none
> ratool -ap <CARD NAME> -ssid RalinkAP
```

2. OPEN(SHARED)/WEP40 - 5-CHAR ASCII WEP KEY

```
> ratool -ap <CARD NAME> -auth open(shared)
> ratool -ap <CARD NAME> -encr wep
> ratool -ap <CARD NAME> -key 1/remove(optional)
> ratool -ap <CARD NAME> -key 1/12345
> ratool -ap <CARD NAME> -ssid RalinkAP
```

3. WPA-PSK(WPA2-PSK)/TKIP(AES) - 8~63-CHAR ASCII PASSPHRASE

```
> ratool -ap <CARD NAME> -auth wpa-psk(wpa2-psk)
> ratool -ap <CARD NAME> -encr tkip(aes)
> ratool -ap <CARD NAME> -ssid RalinkAP
> ratool -ap <CARD NAME> -wpa-psk 1234567890abc...xyz...ABC...XYZ
> ratool -ap <CARD NAME> -ssid RalinkAP
```

(1). <CARD NAME> as "PCI\RT611", "PCI\RT28601", "RT2501USB1" or "RT28701" depends on your hardware.



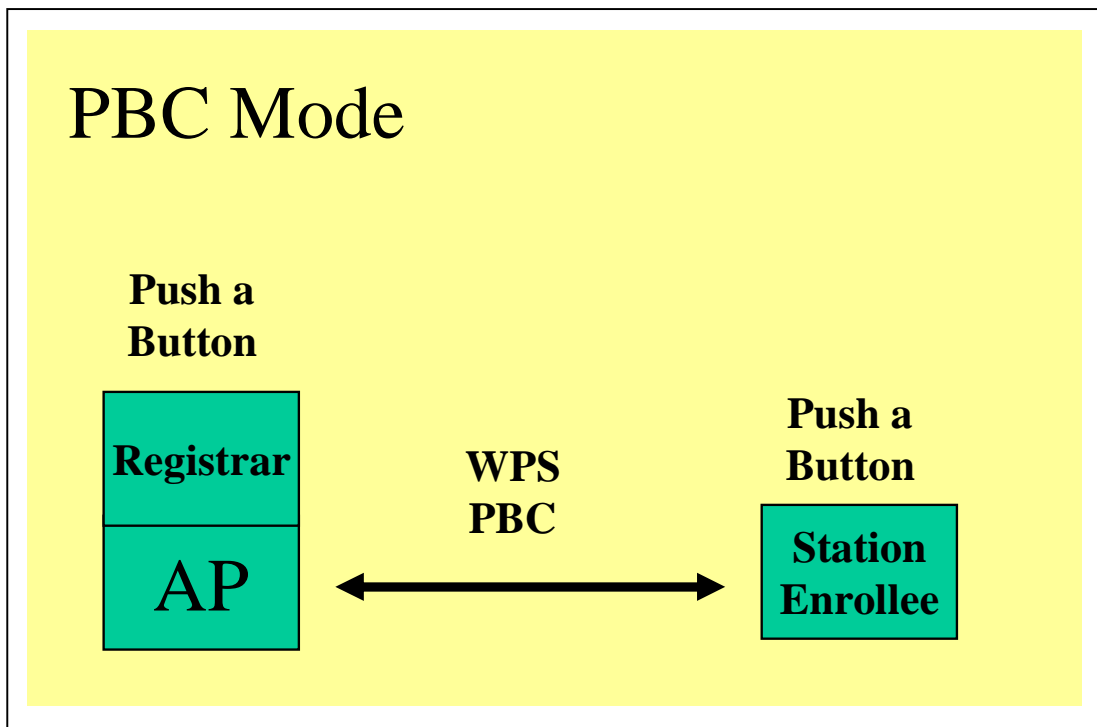
8. Wi-Fi Protected Setup Overview

WPS introduced by the Wi-Fi Alliance to help standardize and simplify ways of setting up and configuring security on a wireless network.

Traditionally, users would have to manually create a wireless network name (SSID), security mode and security key on both the AP and the station to access to their wireless network. This whole process requires the users to have the knowledge and the ability to make the necessary configuration changes.

WPS was introduced to relieve and remove all of the complex wireless setting by typing a PIN code(8 digits numbers) or pushing a button (PBC).

On a wireless network, WPS will automatically configure a wireless network with a network name (SSID) and strong WPA data encryption and authentication.
Currently, WPS does not support "Ad-Hoc" mode.



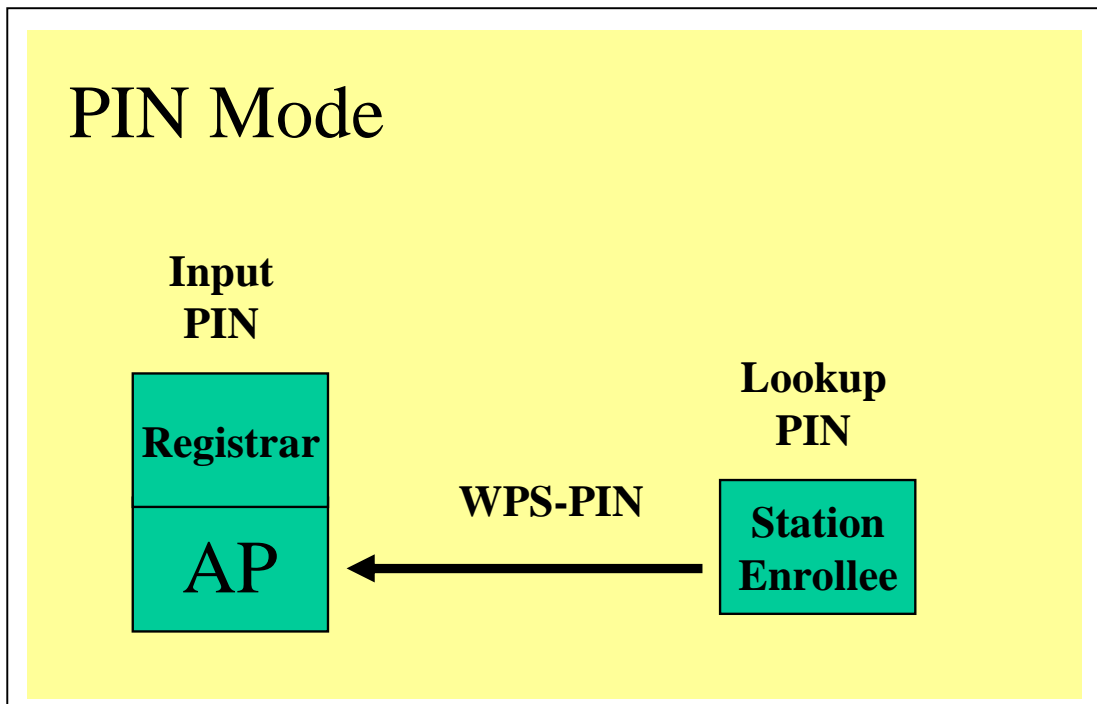
```
> ratool -disablewzcsvc <CARD NAME>(2)
> ratool -wps <CARD NAME> -info
> ratool -wps <CARD NAME> -bssidlist ;Push button on Registrar(1)
> ratool -wps <CARD NAME> -pbc [Or push hardware button on wireless
card]

> ratool -wps <CARD NAME> -status auto
> ratool -wps <CARD NAME> -profile 1(3)
> ratool -enablewzcsvc <CARD NAME>
```

(1). Start PBC on the Registrar.

(2). <CARD NAME> as "PCI\RT611", "PCI\RT28601", "RT2501USB1" or "RT28701" depends on your hardware.

(3). If the registration is successful, the Enrollee will be given the configuration profiles. The Enrollee can connect to the AP with these new parameters.



```

> ratool -disablewzcsvc <CARD NAME> (2)
> ratool -wps <CARD NAME> -info      ; PIN will be listed
> ratool -wps <CARD NAME> -bssidlist
Key PIN on Registrar(1)
> ratool -wps <CARD NAME> -pin YourSsid
> ratool -wps <CARD NAME> -status auto
> ratool -wps <CARD NAME> -profile 1 (3)
> ratool -enablewzcsvc <CARD NAME>
  
```

(1). Enter the Enrollee's PIN code on the Registrar and start WPS on the Registrar.

Note: How to get the Enrollee PIN code? Use 'ratool -wps <CARD NAME> -info' on the Enrollee.

(2). <CARD NAME> as "PC\RT611", "PC\RT28601", "RT2501USB1" or "RT28701" depends on your hardware.

(3). If the registration is successful, the Enrollee will be given the configuration profiles. The Enrollee can connect to the AP with these new parameters.

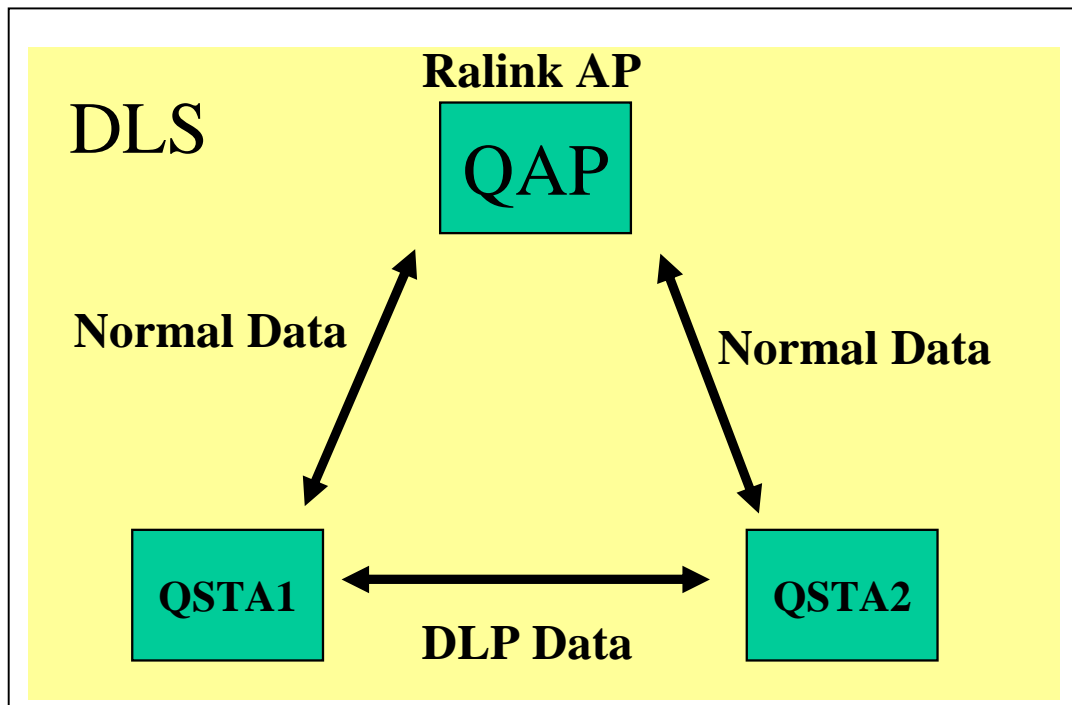


9. Direct-Link Setup (DLS) Overview

The IEEE 802.11e standard supports a Direct-Link Setup (DLS) mechanism optionally to improve the throughput. Using this mechanism, IEEE 802.11e stations in proximity can directly exchange frames with no intervention of an access point.

Direct Link Setup allows direct station-to-station frame transfer in infrastructure mode. Traditionally, the data traffic has been passed through AP between peer stations. In DLS, the station can communicate another peer station directly in a same network. The throughput can be improved due to direct communicate each other peer stations.

Note: Currently, the DLS feature is only supported by Ralink product.



```

> ratool -cmn <card name> -wmm 1 //Enable WMM capable
> ratool -dls <card name> -enable //Enable DLS capable
> ratool -dls <card name> -peer 001150bbc0f2 -t 0
                                //DLS connect to peer MAC address
                                //00-11-50-bb-c0-f2 with timeout value 0
> ratool -dls <card name> -list //Query DLS entry list
> ratool -dls <card name> -teardown 001150bbc0f2
                                //Teardown the DLS connect of MAC
                                //address 00-11-50-bb-c0-f2
> ratool -dls <card name> -disable //Disable DLS capable
> ratool -cmn <card name> -wmm 0 //Disable WMM capability

```

(1). DLS can be supported, when both AP and Stations are Ralink.

(2). <CARD NAME> as "PCI\RT611", "PCI\RT28601", "RT2501USB1" or "RT28701" depends on your hardware.



10. Appendix

1. WZC Autoconfig source code is in
_WINCEROOT\PUBLIC\COMMON\OAK\DRIVERS\NETUI\
2. WZCTOOL source code is in
_WINCEROOT\PUBLIC\COMMON\OAK\DRIVERS\NETSAMP\WZCTOOL\
3. The user can add the Internet Connection Sharing(ICS) feature into Windows CE kernel. Combining with the Ralink wireless AP mode, the Windows CE system can provide DHCP server and NAT.
4. To measure throughput and CPU utilization, the CETK can be applied.
5. Please refer to the blog for more information: <http://ralinkce.blogspot.com/>.