



RALINK TECHNOLOGY, CORP.

RT2870 Software Release Note for WinCE

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Product Name	RT2870 Wireless Adaptor
Interface Supported	USB
Package Version	1.4.1.0R1
FW Version	0.14
Driver Version	1.4.1.0R1
Date	2009-04-16



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1. Introduction

This document guides you how to setup the Ralink RT2870 series driver in Windows CE operating system. Please refer to the blog for more information:

<http://ralinkce.blogspot.com/>.

2. Hardware Requirements

The adapters which made by Ralink RT2870 chipset are supported. Check the link the link <http://ralinkce.blogspot.com/2007/09/support-manufacturerdevice-list-for.html> to find your hardware is supported or not.

Note:

(i). The driver are included the RT3070, RT2070 and RT2770 chips.

3. Software Requirements

1. Platform Builder 5.0 or VS2005+Windows CE 6.0
2. Windows CE 5.0 QFE20061231 is a plus. The WPA2 is supported after this QEF.
3. Windows CE5.0/6.0 QFE2007M6 is a plus. The EHCI host driver is updated in this QFE.



4. Wireless Features

- 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
- AP Mode
 - i. Open/None
 - ii. Open,Shared/WEP
 - iii. WPA-PSK/TKIP,AES
 - iv. WPA2-PSK/TKIP,AES, TKIPAES(Mixed)
 - v. WPA1PSKWPA2PSK/ TKIP,AES
- WPS Enrollee(Station mode only)
 - i. PIN
 - ii. PBC
- Ratool
 - Ralink Wireless Configure Tool for CMD

Note:

(i). Windows CE 5.0 QFE20061231 is necessary to support WPA2 security features



5. Build Image(NK.BIN) Instructions

1. Put *.dll and *.bin in your \WINCE500\PROJECT\XXXXX\RelDir\
2. Add *.bib and *.reg into your project
3. Change your registry file if you want to change driver default parameters.
4. Rebuild your image
5. After start up, WZC Autoconfig will pop up on screen



6. Registry Setting Description

1. Please change REGISTRY FILE and match your desired device

```
[HKEY_LOCAL_MACHINE\Comm\RT2870]
```

```
"DisplayName"="Ralink RT2870 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"
```

```
[HKEY_LOCAL_MACHINE\Comm\RT2871\Parms]
```

```
; "CustomizedVID"=dword:148f ; hex
```

```
; "CustomizedPID"=dword:2870 ; hex
```

```
; Use internal table, 1: Use external pair, 2: both
```

```
; "CustomizedControlFlag"=dword:0;
```

Note:

(i). If you found your VID/PID pair of the device does not match the internal table of the driver, you can add your VID/PID pair for your device.

2. AP Mode Registry Setting Example:

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

```
"OpMode"=dword:1
```

```
"Channel"=dword:1 ; 1~14
```

```
"SSID"=" RalinkAP-WinCE" ; Max 32-char ascii
```

```
"AuthenType"=dword:0
```

```
; 0: OPEN
```

```
; 1: SHARED
```

```
; 4: WPA-PSK
```

```
; 7: WPA2-PSK
```

```
; 9: WPAPSK-WPA2PSK
```

```
"Encryption"=dword:1
```

```
; 1: NONE
```

```
; 0: WEP
```



```
;      4: TKIP
;      6: AES
;      8: TKIPAES

"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"="432985e9d4167362a98f3598f17285dd23f8403171f679c2bece83c6c78b34
c9"

;      WPA-PSK or WPA2-PSK's 64-char hexadecimal PMK only
```

Note:

- (i). Rebuild the image and load on the platform.
- (ii). After system boot, the driver will be loaded.
- (iii). The auto-config utility for wireless must be disabled when wireless driver is working in AP mode.
- (iv). Authentication and Encryption Combinations as bellow:

- OPEN/NONE
- OPEN/WEP
- SHARED/WEP
- WPA-PSK/TKIP
- WPA-PSK/AES
- WPA2-PSK/TKIP
- WPA2-PSK/AES
- WPA2-PSK/TKIPAES



WPAPSKWPA2PSK/TKIP

WPAPSKWPA2PSK/AES

- (v). A pass phrase is needed to use wpa_passphrase.exe to generate the PMK in registry
- (vi). Internet Connection Sharing in CE can be enabled for AP mode. Details can be found in help file or on the MSDN.



7. Ratool Description

Ratool is a wireless utility for Windows CE command shell. 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

AP Command Example

1. OPEN/NONE

```
> ratool -ap [-save or -s] RT28701 -auth open
> ratool -ap [-save] RT28701 -encr none
> ratool -ap [-save] RT28701 -ssid RalinkAP
```

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

```
> ratool -ap [-save] RT28701 -auth open(shared)
> ratool -ap [-save] RT28701 -encr wep
> ratool -ap [-save] RT28701 -key 1/remove(optional)
> ratool -ap [-save] RT28701 -key 1/12345
> ratool -ap [-save] RT28701 -ssid RalinkAP
```

3. OPEN(SHARED)/WEP40 - 10-CHAR HEXA WEP KEY

```
> ratool -ap [-save] RT28701 -auth open(shared)
> ratool -ap [-save] RT28701 -encr wep
> ratool -ap [-save] RT28701 -key 1/remove(optional)
> ratool -ap [-save] RT28701 -key 1/12345abcde
> ratool -ap [-save] RT28701 -ssid RalinkAP
```

4. OPEN(SHARED)/WEP128 - 13-CHAR ASCII WEP KEY

```
> ratool -ap [-save] RT28701 -auth open(shared)
> ratool -ap [-save] RT28701 -encr wep
> ratool -ap [-save] RT28701 -key 2/remove(optional)
> ratool -ap [-save] RT28701 -key 2/abcdefghijklm
> ratool -ap [-save] RT28701 -ssid RalinkAP
```

5. OPEN(SHARED)/WEP40 - 26-CHAR HEXA WEP KEY

```
> ratool -ap [-save] RT28701 -auth open(shared)
> ratool -ap [-save] RT28701 -encr wep
```



```
> ratool -ap [-save] RT28701 -key 3/remove(optional)
> ratool -ap [-save] RT28701 -key 3/12345678901234567890abcdef
> ratool -ap [-save] RT28701 -ssid RalinkAP
```

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

```
> ratool -ap [-save] RT28701 -auth wpa-psk(wpa2-psk)
> ratool -ap [-save] RT28701 -encr tkip(aes)
> ratool -ap [-save] RT28701 -ssid RalinkAP
> ratool -ap [-save] RT28701 -wpa-psk 1234567890abc...xyz...ABC...XYZ
> ratool -ap [-save] RT28701 -ssid RalinkAP
```

7. WPA-PSK(WPA2-PSK)/TKIP(AES) - 64-CHAR HEXA KEY

```
> ratool -ap [-save] RT28701 -auth wpa-psk(wpa2-psk)
> ratool -ap [-save] RT28701 -encr tkip(aes)
> ratool -ap [-save] RT28701 -wpa-psk 12345abcdef...67890abcdef
> ratool -ap [-save] RT28701 -ssid RalinkAP
```

Note:

(i). You can use “-save” or “-s” option to save the setting into registry. The setting will be reloaded when driver reloaded.

WPS Command Example:

1. Configure with PIN mode:

```
> ratool -disablewzcsvc RT28701
> ratool -wps RT28701 -info      ; PIN will be listed
> ratool -wps RT28701 -bssidlist
Key PIN on Registrar(i)
> ratool -wps RT28701 -pin YourSsid
> ratool -wps RT28701 -status auto
> ratool -wps RT28701 -profile 1(ii)
> ratool -enablewzcsvc RT28701
```

(i). 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 R28701 -info' on the Enrollee.

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



2. Configure with PBC mode:

```
> ratool -disablewzcsvc RT28701
> ratool -wps RT28701 -info
> ratool -wps RT28701 -bssidlist
Push button on Registrar(i)
> ratool -wps RT28701 -pbc [Or push hardware button on wireless card]
> ratool -wps RT28701 -status auto
> ratool -wps RT28701 -profile 1(ii)
> ratool -enablewzcsvc RT28701
```

(i). Start PBC on the Registrar.

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



8. Wi-Fi Protected Setup Overview

This section presents a high-level description of the Wi-Fi Protected Setup(WPS) architecture. Figure 1 depicts the major components and their interfaces as defined by Wi-Fi Protected Setup Spec. There are three logical components involved: the Registrar, the access point (AP), and the Enrollee.

The Enrollee is a device seeking to join a WLAN domain. Once an Enrollee obtains a valid credential, it becomes a member.

A Registrar is an entity with the authority to issue and revoke domain credentials. A registrar can be integrated into an AP.

The AP can be either a WLAN AP or a wireless router.

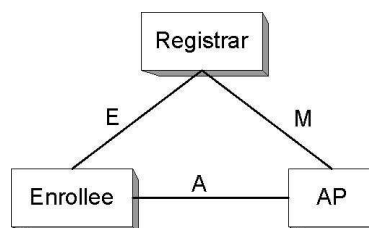


Figure 1. Components and Interfaces

Registration initiation is ordinarily accomplished by a user action such as powering up the Enrollee and, optionally, running a setup wizard on the Registrar (PC).



9. Direct-Link Setup (DLS)

9.1 What is Direct-Link Setup

IEEE 802.11e offer QoS facility on wireless network. One of the effective ways is Direct-Link Setup (DLS). STAs with QoS facility (i.e., QSTAs) may transmit frames directly to another QSTA by setting up such data transfer using DLS.

9.1.1 DLS operation

The need for this protocol is motivated by the fact that the intended recipient may be in PS mode, in which case it can be awakened only by the QAP. This protocol prohibits the STAs going into PS mode for the duration of the direct stream as long as there is an active DLS between the two STAs. DLS does not apply in a QIBSS, where frames are always sent directly from one STA to another.

The handshake involved in the setup is illustrated in Figure 1 and involves the four steps listed after the figure.

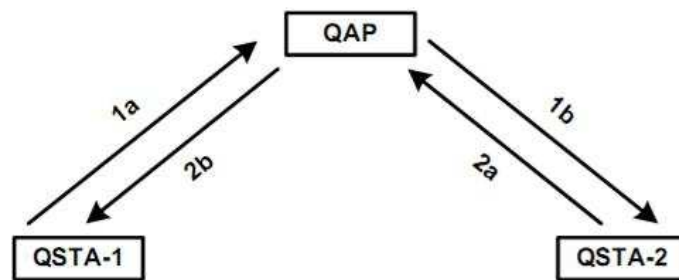


Figure 1 – The four steps involved in direct-link handshake.

- 1a) A STA, QSTA-1, that intends to exchange frames directly with another non-AP STA, QSTA-2, invokes DLS and sends a DLS Request frame to the QAP.
- 1b) If QSTA-2 is associated in the BSS, direct streams are allowed in the policy of the BSS, and QSTA-2 is indeed a QSTA, then the QAP forwards the DLS Request frame to the recipient, QSTA-2.
- 2a) If QSTA-2 accepts the direct stream, it sends a DLS Response frame to the QAP.
- 2b) The QAP forwards the DLS Response frame to QSTA-1, after which the direct link becomes active and frames can be sent from QSTA-1 to QSTA-2 and from QSTA-2 to QSTA-1.



9.1.2 DLS teardown

The DLS Teardown frame is sent to terminate a direct link with a peer MAC. If QSTA-1 intends to teardown DLS connection with QSTA-2, QSTA-1 sends a Teardown frame to the QAP, then the QAP forwards the DLS Teardown frame to the recipient, QSTA-2. Upon receipt of the DLS Teardown frame (from the QAP), the QSTA-2 shall delete the QSTA from the list of the QSTAs with which direct link has been established.

9.1.3 Error Recovery upon a Peer Failure

Every STA shall maintain an inactivity timer for every negotiated direct link (i.e., STAs on both sides of the link maintain these timers). The DLS inactivity timer shall be reset for every successful frame transmission or reception for that direct link. The direct link becomes inactive when no frames have been exchanged as part of the direct link for the duration of DLS timeout value. When the direct link becomes inactive due to the timeout, the MAC sends a DLS Teardown frame to the QAP, with the peer MAC address as the destination MAC address. All frames shall henceforth be sent via the QAP.

The DLS Timeout Value contains the duration, in seconds, after which the direct link is terminated, if there are no frame exchanges within this duration with the peer. A value of 0 implies that the direct link is never to be terminated based on a timeout.

9.2 How to use DLS in WCE

Ratool is a wireless utility for Windows CE command shell. It added DLS feature with Ralink OID functions in version 2.2.0.7. This is detailed explanation of each parameter for DLS command.

Note:

[]: mandatory <>: optional

USAGE:

>ratool -[act] <wireless card name> -[parameter] [val]

where

[act]	[parameter]	[val] constraints	explanation
-------	-------------	-------------------	-------------

9.2.1 act::cmn

9.2.1.1 parameter::swmm

[val] constraints::

0~1



Explanation: set WMM capability to wireless card.

1 - enable 0 - disable

9.2.2 act::dls

9.2.2.1 parameter::enable

Explanation: enable DLS capability to wireless card.

9.2.2.2 parameter::disable

Explanation: disable DLS capability to wireless card.

9.2.2.3 parameter::peer

[val] constraints::

xxxxxxxxxxxxx

Explanation: set DLS connection to peer MAC address

(xx-xx-xx-xx-xx-xx) with default timeout value 60 second.

If you want to set the timeout value, you shall add command

<-t time> after [val].

Time 0 implies dls never be teardown by timeout.

Ex. > ratool -dls <card name> -peer 001150bbc0f2 -t 120

9.2.2.4 parameter::list

Explanation: query the DLS entry list.

9.2.2.5 parameter::teardown

[val] constraints::

xxxxxxxxxxxxx

Explanation: teardown the DLS connection of MAC address.

(xx-xx-xx-xx-xx-xx)

9.3 DLS Command example

> ratool -cmn <card name> -swmm 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> -swmm 0 //Disable WMM capability
```

9.4 Reference

- [1] IEEE Std 802.11e-2005, Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications
- [2] Ralink RaUI Version 2.2.4.4 Source Code
- [3] RT2501USB WinCE5.0 Version 1.3.2.8 Source Code



10. Appendix

1. WZC Autoconfig source code is in
 \WINCE500\PUBLIC\COMMON\OAK\DRIVERS\NETUI\
2. WZCTOOL source code is in
 \WINCE500\PUBLIC\COMMON\OAK\DRIVERS\NETSAMP\WZCTOOL\
3. The user can add the Internet Connection Sharing or Bridge features to Windows CE kernel in AP mode.