MT7986 Smart Carrier Sensing

2021/09/24

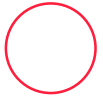
Outline

- Introduction
- Motivation
- Smart Carrier Sense Concept
- Limitation
- Command

Introduction

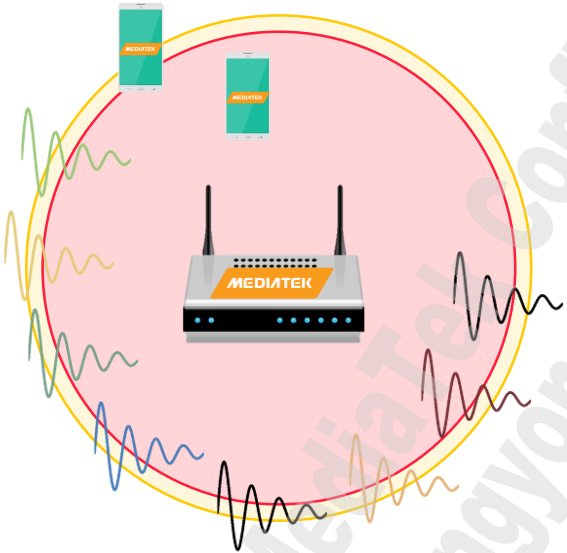
Other Legal wifi packet and ACI/CCI

AP Physical Rx Sensitivity

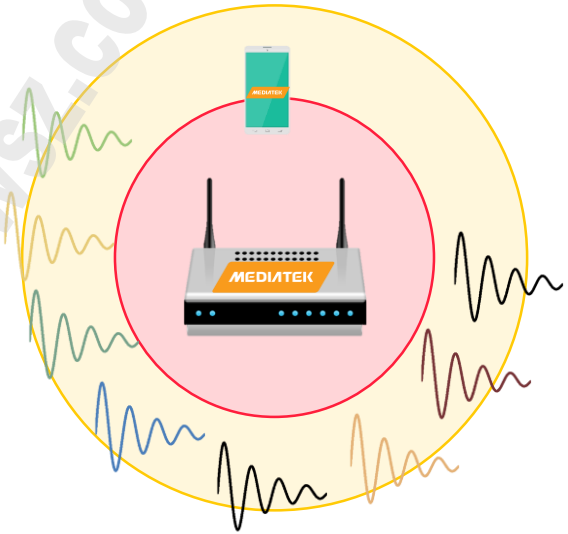


SCS Adjustment Rx Range

- **Improve 2.4G/5G OTA/Noisy Throughput Performance**



If there are long range/short range STA → keep good Rx sensitivity



If there are only short range STA → adjust Rx range to ignore legal wifi packet and ACI/CCI → Increase Tx opportunities

Hardware Physical Rx Sensitivity (Default)
OFDM sensitivity = -98dBm
CCK sensitivity = -110dBm

IEEE CSCCA Spec

- **IEEE802.11a: OFDM CSCCA spec is -82dBm, EDCCA spec is -62dBm**

17.3.10.5 CCA sensitivity

The start of a valid OFDM transmission at a receive level equal to or greater than the minimum 6 Mbit/s sensitivity (-82 dBm) shall cause CCA to indicate busy with a probability >90% within 4 μs. If the preamble portion was missed, the receiver shall hold the carrier sense (CS) signal busy for any signal 20 dB above the minimum 6 Mbit/s sensitivity (-62 dBm).

- **IEEE802.11: define CS function and CCK 2M sensitivity = -80dBm**

15.4.8.1 Receiver minimum input level sensitivity

The frame error ratio (FER) shall be less than 8×10^{-2} at an MPDU length of 1024 bytes for an input level of –80 dBm measured at the antenna connector. This FER shall be specified for 2 Mbit/s DQPSK modulation. The test for the minimum input level sensitivity shall be conducted with the energy detection threshold set ≤ –80 dBm.

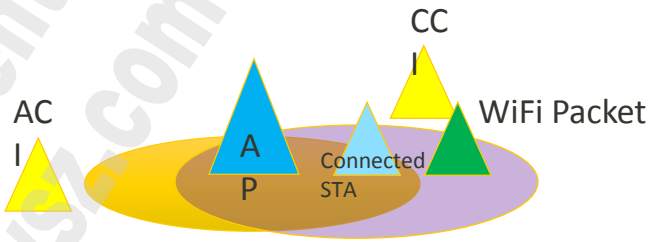
Table 91—Receiver performance requirements

Data rate (Mbits/s)	Minimum sensitivity (dBm)	Adjacent channel rejection (dB)	Alterna channel r
6	–82	16	
9	–81	15	
12	–79	13	
18	–77	11	
24	–74	8	
36	–70	4	

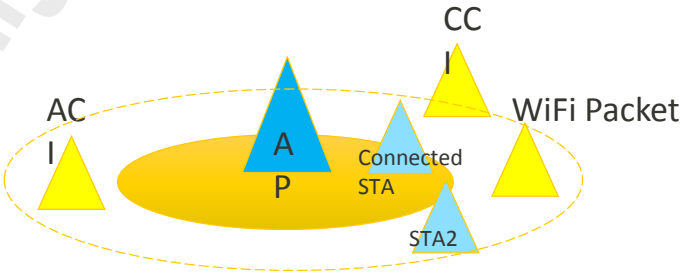
- **Thus IEEE defined CCK/OFDM CS sensitivity**
  - **CCK 2M: -80dBm**
  - **OFDM 6M: -82dBm**

Limitation

- **Hidden node close to STA.**

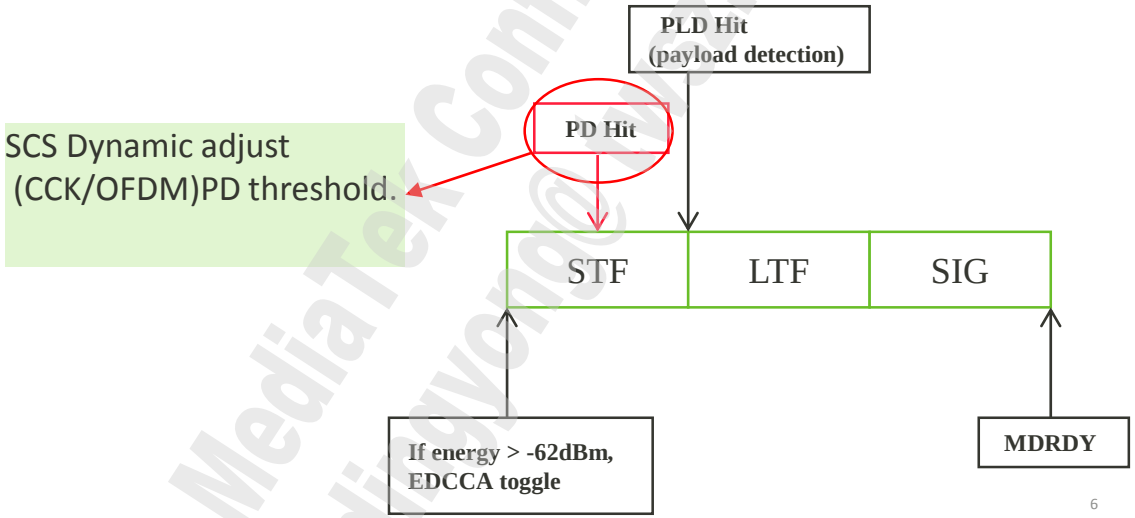


- **Far STA can’t connect to AP during PD blocking enabled.**



Smart Carrier Sense Mechanism

- **Mechanism**
  - **PD blocking threshold.**



CCA Detection Procedure

MT7986 Smart Carrier Sense

- **Alpha Branch MP version only supports SCS on Band0**
- **MT7986 SCS Characteristics**
  - **Entry Condition: Channel congestion, Low TX airtime and traffic Busy**
    - Only Activated when there's only 1 active station (with throughput)
  - **Measurement Indicators: Effective throughput**
  - **Activated in Channel busy condition (both ACI and CCI Scenario)**
  - **Adjust Pd by monitoring effective throughput**

Driver Config

- **Must Enable Configuration in driver:**

COFIG	Note	Path
SMART_CARRIER_SENSE_SUPPORT	Kconfig	Eg. Jedi/os/linux/Kconfig.mt_wifi_4_4 Jedi/os/linux/Kconfig.mt_wifi_3_18 Jedi/os/linux/Kconfig.mt_wifi
CONFIG_MTK_SCS_FW_OFFLOAD	SDK menuconfig	Eg: lede/autobuild/mt7621-mt7986-AX6000/.config

MT7986 CR for PD Threshold

- PD_BLK_TH Band0:

CR address	LSB MSB	Description		
830A611C	1 8	CCK	CR_CCK_PD_SEN_LIMITED	Formula : Value + 256 ex: -70 + 256 = 186 (0xBA)
830A6120	24 31	CCK 1R	CR_CCK_PD_SEN_LIMITED_1R	
830884f0	20 28	OFDM	CR_BAND0_MIN_PRI_PWR_DBM	Formula : Value*2 + 512 ex: -70*2 + 512 = 374 (0x174)
830884f0	19 19	OFDM enable	CR_BAND0_MIN_PRI_PWR_EN	

- PD_BLK_TH Band1:

CR address	LSB MSB	Description		
831A611C	1 8	CCK	CR_CCK_PD_SEN_LIMITED	Formula : Value + 256 ex: -70 + 256 = 186 (0xBA)
831A6120	24 31	CCK 1R	CR_CCK_PD_SEN_LIMITED_1R	
831884f0	20 28	OFDM	CR_BAND0_MIN_PRI_PWR_DBM	Formula : Value*2 + 512 ex: -70*2 + 512 = 374 (0x174)
831884f0	19 19	OFDM enable	CR_BAND0_MIN_PRI_PWR_EN	

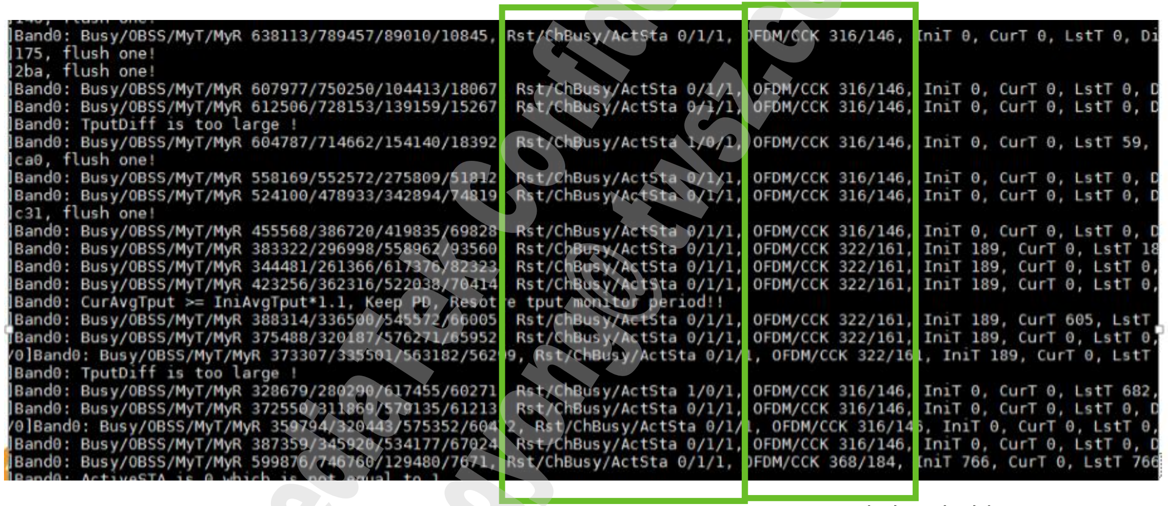
- Default Pd Threshold
  - Default_PD_Upper_Bound = -72dBm
  - Default_PD_Lower_Bound = -110dBm

SCS Command

- **SCS enable for Band0 :**
  - **iwpriv ra0 set SCSEnable=0/1 (Disable/Enable Default Enable)**
- **SCS enable for Band1 :**
  - **iwpriv rax0 set SCSEnable=0/1 (Disable/Enable)**
- **SCS log enable**
  - **iwpriv ra0 set SCSEnable=2 | iwpriv ra0 set fwlog=0:3**

SCS Command (for Debug) – 1/2

- Dump SCS status every 0.5 sec
  - iwpriv ra0 set fwlog=0:2



```
]Band0: Busy/OBSS/MyT/MyR 638113/789457/89010/10845, Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 0, Di
]175, flush one!
]2ba, flush one!
]Band0: Busy/OBSS/MyT/MyR 607977/750250/104413/18067  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 0, D
]Band0: Busy/OBSS/MyT/MyR 612506/728153/139159/15267  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 0, D
]Band0: TputDiff is too large !
]Band0: Busy/OBSS/MyT/MyR 604787/714662/154140/18392  Rst/ChBusy/ActSta 1/0/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 59,
]ca0, flush one!
]Band0: Busy/OBSS/MyT/MyR 558169/552572/275809/51812  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 0, D
]Band0: Busy/OBSS/MyT/MyR 524100/478933/342894/74819  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 0, D
]c31, flush one!
]Band0: Busy/OBSS/MyT/MyR 455568/386720/419835/69828  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 0, D
]Band0: Busy/OBSS/MyT/MyR 383322/296998/558962/93560  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 322/161, IniT 189, CurT 0, LstT 18
]Band0: Busy/OBSS/MyT/MyR 344481/261366/617376/82323  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 322/161, IniT 189, CurT 0, LstT 0,
]Band0: Busy/OBSS/MyT/MyR 423256/362316/522038/70414  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 322/161, IniT 189, CurT 0, LstT 0,
]Band0: CurAvgTput >= IniAvgTput*1.1, Keep PD, Restore tput monitor period!!
]Band0: Busy/OBSS/MyT/MyR 388314/336500/545572/66005  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 322/161, IniT 189, CurT 605, LstT
]Band0: Busy/OBSS/MyT/MyR 375488/320187/576271/65952  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 322/161, IniT 189, CurT 0, LstT 0,
/0]Band0: Busy/OBSS/MyT/MyR 373307/335501/563182/56209, Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 322/161, IniT 189, CurT 0, LstT
]Band0: TputDiff is too large !
]Band0: Busy/OBSS/MyT/MyR 328679/280290/617455/60271  Rst/ChBusy/ActSta 1/0/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 682,
]Band0: Busy/OBSS/MyT/MyR 372550/311869/579135/61213  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 0, D
/0]Band0: Busy/OBSS/MyT/MyR 359794/320443/575352/60412, Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 0,
]Band0: Busy/OBSS/MyT/MyR 387359/345920/534177/67024  Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 316/146, IniT 0, CurT 0, LstT 0, D
]Band0: Busy/OBSS/MyT/MyR 599876/746760/129480/7671, Rst/ChBusy/ActSta 0/1/1, OFDM/CCK 368/184, IniT 766, CurT 0, LstT 766
```

PDReset Flag
ChanBusyFlag
ActiveSTA number

OFDM Pd Threshold
CCK Pd Threshold

SCS Command (for Debug) – 2/2

- **Dump all SCS Related Variables in Firmware:**
  - **Step1 : Fetch address of FW global data structure**
    - iwpriv ra0 show get_scs_glo_addr

```
rootPLEDE:/#
rootPLEDE:/#  Get address of global data structure
rootPLEDE:/# iwpriv ra0 show get_scs_glo_addr
[  368.069801] ShowScsGloAddr:
[  368.072608] scsEventDispatcher: u4EventId = 6, len = 24
[  368.078828] scsEventDispatcher: SCS_EVENT_GET_GLO_ADDR
[  368.083161] scs_get_glo_addr_handler:SCS_EVENT_GET_GLO_ADDR
[  368.088728] eventId 6
[  368.091064] ShowScsGloAddr:(Ret = 1
```

  - **Step 2: Dump data via address (both for Band0 and Band1)**
    - iwpriv ra0 show SCSInfo_2