

## RF Exposure evaluation for SAR/MPE configuration in co-locating with other transmitters

### 1. Outline

The Figure-1 indicates the specific host PC devices in this application which were previously certified by the Commission and IC for the applying WWAN modular device (FCC ID: **VV7-MBM F3507G-L**, IC: **287AG-MBMF3507G**) on April 27, 2009 under the Portable category regarding FCC CFR 47 Section 2.1093, and on May 04, 2009 under the "SAR Evaluation" category pursuant to IC RSS-102e clause 2.5.1.

The applying WWAN modular device transmits RF simultaneously with the three kinds of transmitters listed below.

- |                       |                           |                     |
|-----------------------|---------------------------|---------------------|
| 1. Bluetooth:         | FCC ID: QDS-BRCM1033      | IC: 4324A-BRCM1033  |
| 2. UWB:               | FCC ID: TX2RTU7305BG13HMC | N/A                 |
| 3. one of WLAN/WiMAX: | FCC ID: PD9533ANMU        | IC: 1000M-533ANMU   |
|                       | FCC ID: PD9533ANXMU       | N/A                 |
|                       | FCC ID: PD9LEN512ANMU     | IC: 1000M-L512ANMU  |
|                       | FCC ID: PPD-AR5BHB63-L    | IC: 4104A-ARBHB63L  |
|                       | FCC ID: PD9533ANHU        | IC: 1000M-533ANHU   |
|                       | FCC ID: PD9512ANHU        | IC: 1000M-512ANHU   |
|                       | FCC ID: PD9512ANXMU       | N/A                 |
|                       | FCC ID: PD9512ANXHU       | N/A                 |
|                       | FCC ID: TX2-RTL8191SE-L   | IC: 6317A-RTL8191SE |
|                       | *1 FCC ID: PD9112BNHU     | IC: 1000M-112BNHU   |

\*1: New co-located WLAN transmitter device to be added in this Class II application

\*2 : additional **SAR/MPE** co-location with WWAN and WLAN transmitter device in this application

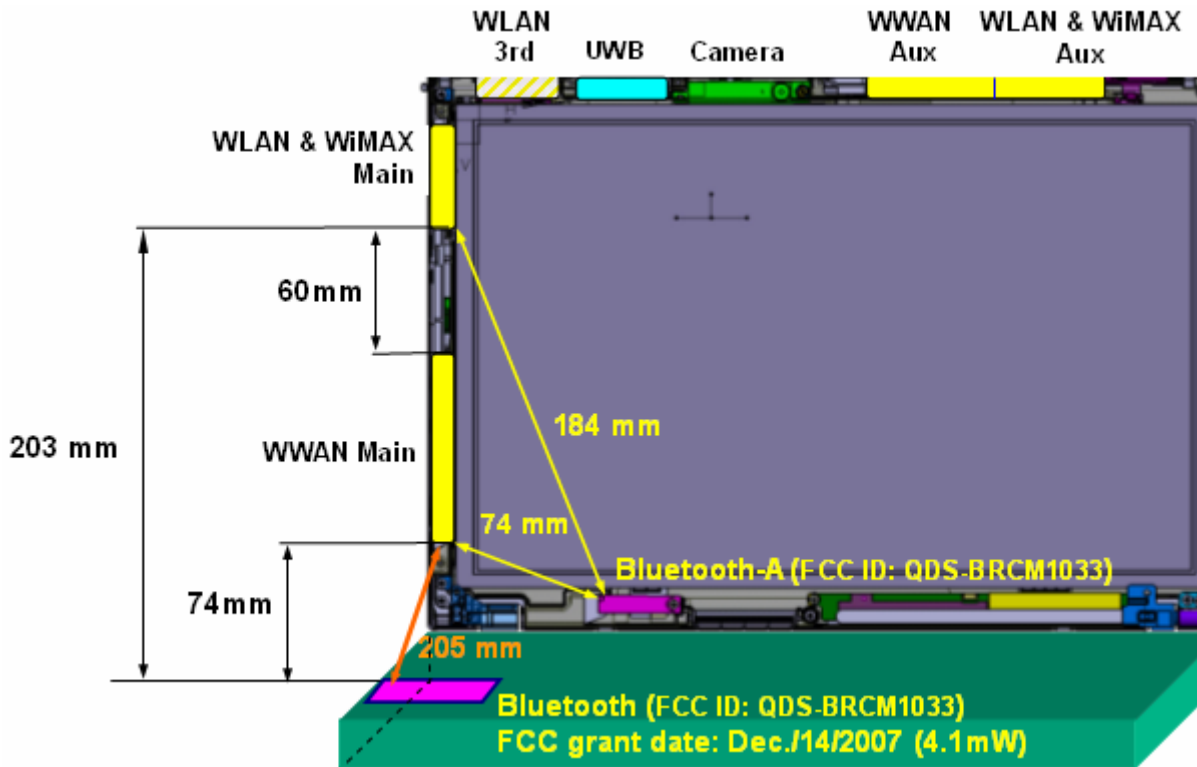
as of June/2009

	SAR / MPE config.
Co-located WLAN/WiMAX modules	ThinkPad T400/R400/T500/W500
FCC ID: PD9533ANMU IC: 1000M-533ANMU	granted FCC: 08/05/2008 IC: 02/06/2009
FCC ID: PD9LEN512ANMU IC: 1000M-L512ANMU	
FCC ID: PPD-AR5BHB63-L IC: 4104A-ARBHB63L	
FCC ID: PD9533ANXMU IC: N/A	granted FCC: 10/16/2008
FCC ID: PD9533ANHU IC: 1000M-533ANHU	granted FCC: 04/27/2009 IC: 05/04/2009
FCC ID: PD9512ANHU IC: 1000M-512ANHU	
FCC ID: PD9512ANXMU IC: N/A	
FCC ID: PD9533ANHMU IC: N/A	
FCC ID: TX2-RTL8191SE-L IC: 6317A-RTL8191SE	
FCC ID: PD9112BNHU IC: 1000M-112BNHU	*2

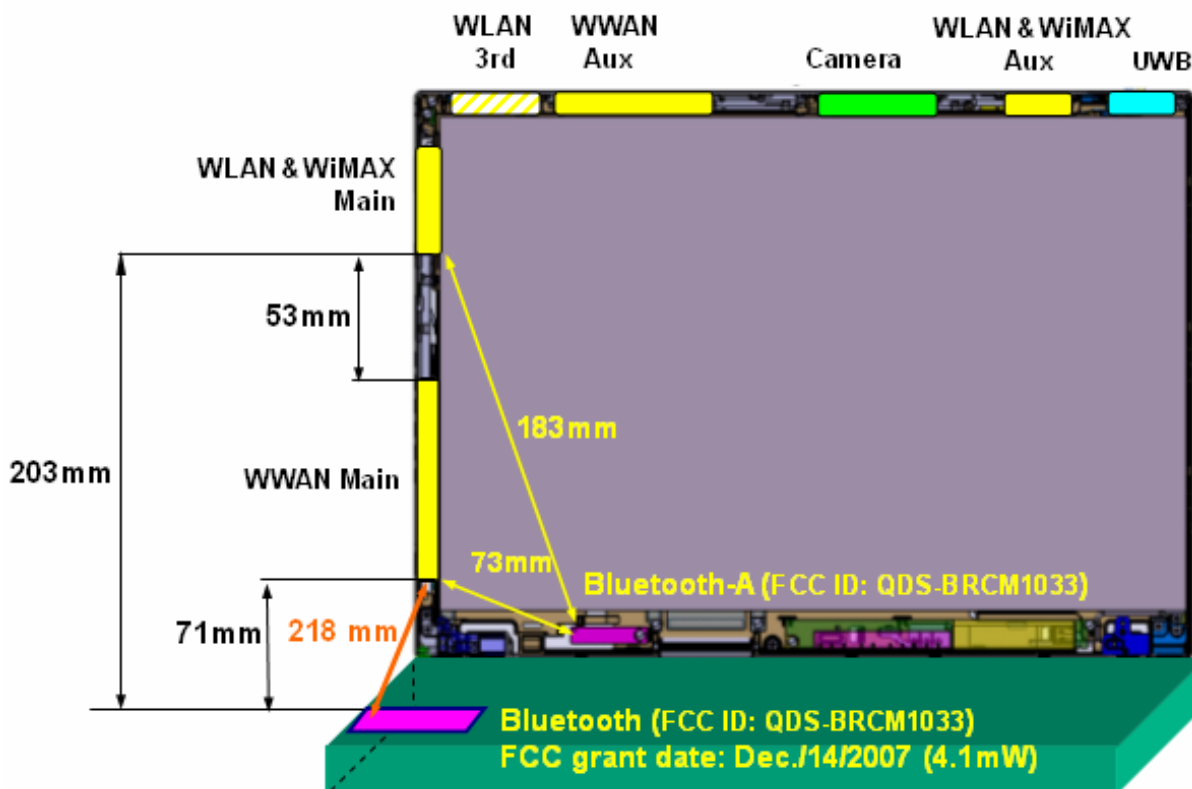
See Annex-1 in more details for the grant history.

Figure-1: Exterior views of the host PC devices

**ThinkPad T400/R400 Series**



**ThinkPad T500/W500 Series**



The separation distance between human body and the WWAN Tx antenna of the host PC devices is 74mm or less. Therefore the applying WWAN transmitter module (Model: **F3507G**) and the antenna systems are subjected to "Portable device" pursuant to FCC CFR 47 Section 2.1093 and "SAR Evaluation" category pursuant to IC RSS-102e clause 2.5.1.

With the evaluation hereafter, the applying modular transmitter (FCC ID: VV7-MBMF3507G-L, IC: 287AG-MBMF3507G) has found to comply with the SAR limit pursuant to FCC CFR 47 section 2.1093 for general Population/Uncontrolled exposure and IC RSS-102e clause 4.1.

## **2. RF Exposure justification regarding Bluetooth co-location**

The separation distance between the WWAN and Bluetooth antennas is 73 mm (> 5cm) and the transmission power of Bluetooth is 4.1mW ( $< 60/f_{\text{GHz}}$ ), therefore the co-location evaluation for the Bluetooth device is not required pursuant to FCC KDB 616217 and 447498.

## **3. RF Exposure justification regarding UWB co-location**

UWB transmitter is not mentioned in FCC CFR 47 Section 2.1091 and 2.1093, so it does not subject to RF exposure requirement. Therefore, no additional SAR testing or RF Exposure evaluation is required for any combination with UWB transmitter.

#### 4. RF Exposure evaluation regarding WWAN & WLAN co-location

The WWAN Main antenna falls in “**Portable**” category. On the other hand, the WLAN/WiMAX antennas are “**Mobile**” category.

Therefore, the assessment of “antenna-to-antenna separation distance” between the WWAN and WLAN/WiMAX antennas is required for the RF Exposure co-location evaluation pursuant to KDB 616217.

As shown by Table-1, the “antenna-to-antenna separation distance” is calculated as minimum 12 cm, and the actual separation distance between WWAN and WLAN/WiMAX antennas is 6 cm or less.

**Conclusion:** ..... **Consultation with FCC is required** to this application for simultaneous transmission.

See [Table-2](#) for SAR measurement results of the applying WWAN device, and [Table-3](#) for MPE evaluation concerning the co-located WLAN/WiMAX devices.

**Table-1:** Antenna to Antenna separation distance of WWAN & WLAN/WiMAX modules

1/2 $n_x = 1/2 [P_x / (60/f) - 1]$ (cm) Px: Conducted power of F3507g		1/2 $n_y = 1/2 [P_y / (60/f) - 1]$ (cm) Py: WLAN/WiMAX conducted power See <a href="#">Table-4</a> .			5cm + 1/2 $n_x$ + 1/2 $n_y$		WLAN to WWAN (cm)	Simul Eval?
					Duty 100%	Duty 25%		
WWAN: Cellular	Duty=100% ( <a href="#">Table-2a</a> ) 1/2[ <b>1995</b> /(60/0.836)-1]	14	WLAN 2400MHz	1/2[ <b>632</b> /(60/2.45)-1]	13	32 21	5.3 or 6.0	Yes
			WLAN 5250MHz	1/2[ <b>110</b> /(60/5.25)-1]	5	24 13		Yes
			WLAN 5600MHz	1/2[ <b>110</b> /(60/5.60)-1]	5	24 13		Yes
	Duty=25% ( <a href="#">Table-2a</a> ) 1/2[ <b>499</b> /(60/0.836)-1]	3	WLAN 5785MHz	1/2[ <b>441</b> /(60/5.785)-1]	21	40 29		Yes
			WIMAX 2590MHz	1/2[ <b>254</b> /(60/2.59)-1]	5	24 13		Yes
WWAN: PCS	Duty=100% ( <a href="#">Table-2b</a> ) 1/2[ <b>851</b> /(60/1.880)-1]	13	WLAN 2400MHz	1/2[ <b>632</b> /(60/2.45)-1]	13	31 20		Yes
			WLAN 5250MHz	1/2[ <b>110</b> /(60/5.25)-1]	5	23 <b>12</b>		Yes
			WLAN 5600MHz	1/2[ <b>110</b> /(60/5.60)-1]	5	23 <b>12</b>		Yes
	Duty=25% ( <a href="#">Table-2b</a> ) 1/2[ <b>213</b> /(60/1.880)-1]	2	WLAN 5785MHz	1/2[ <b>441</b> /(60/5.785)-1]	21	39 28		Yes
			WIMAX 2590MHz	1/2[ <b>254</b> /(60/2.59)-1]	5	23 <b>12</b>		Yes

**Table-2:** WWAN (Model: **F3507G**) SAR info.

SAR measurement results: Based upon VV7-MBMF3507G-L (grant date: 05/09/2008)

Host PC model	Initial Grant of the Host PC	FCC CFR IC RSS	Max. Conducted power (P)	SAR Distance (D)	Stand alone SAR (W/Kg)	limit (W/Kg)
ThinkPad T400/R400 ThinkPad T500/W500	FCC 05/09/2008	Part 22H RSS-132	498.82 mW Table-2a	7.4 cm	<b>0.173</b>	1.6
				7.1 cm	<b>0.161</b>	
	IC 02/06/2009	Part 24E RSS-133	212.78 mW Table-2b	7.4 cm	<b>0.112</b>	1.6
				7.1 cm	<b>0.064</b>	

Table-2a: WWAN Maximum Power consideration at 850MHz frequency band

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	33,00	*3 1995,26	25%	<b>498,82</b>
EDGE	31,00	1258,93	25%	314,73
WCDMA	23,62	230,14	100%	230,14
HSDPA	23,49	223,36	100%	223,36
HSUPA	23,08	203,24	100%	203,24

\*3: 2W is the peak output power listed in the original grant (VV7-MBMF3507G). However, based upon the original test report, 1.955W of the peak output power is used here.

Table-2b: WWAN Maximum Power consideration at 1900MHz frequency band

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	29,30	*4 851,14	25%	<b>212,78</b>
EDGE	28,70	741,31	25%	185,33
WCDMA	22,80	190,55	100%	190,55
HSDPA	23,00	199,53	100%	199,53
HSUPA	22,80	190,55	100%	190,55

\*4: 871 mW is the peak output power listed in the original test report (VV7-MBMF3507G). However, 851 mW of the burst-averaged output power in the original test report is used here.

Table-3: MPE of WLAN&WiMAX modules

		Max. Conducted power (See Table-4.) (Py)	Max. Host PC antenna gain (See Table-5.) (G)	MPE *4 (mW/cm <sup>2</sup> )	limit (mW/cm <sup>2</sup> )
Part 15C	2.4GHz band	0.632 W	1.99 dBi	<b>0.199</b>	1.0
Part 15E	5.18– 5.32GHz	0.110 W	2.59 dBi	<b>0.040</b>	
Part 15E	5.50 – 5.70GHz	0.110 W	2.79 dBi	<b>0.042</b>	
Part 15C	5.745 – 5.825GHz	0.441 W	2.46 dBi	<b>0.155</b>	
Part 27	2.496 – 2.690GHz	0.254 W	1.94 dBi	<b>0.079</b>	

$$*4: MPE = (1000 \times P_y) \times (10^{G/10}) / (4 \times \pi \times 20^2)$$

**Table-4:** Conducted peak power of WLAN&WiMAX modules

FCC ID	Original Grant date	WLAN				WiMAX
		Part 15C 2.4GHz band	Part 15E 5.18 – 5.32GHz	Part 15E 5.50 – 5.70GHz	Part 15C 5.745 – 5.825GHz	Part 27 2.496 – 2.690GHz
PPD-AR5BHB63-L	03 / 24 /2008	0.1977W	N/A	N/A	N/A	N/A
PD9LEN512ANMU	06 / 24 /2008	0.091 W	0.028 W	0.054 W	0.021 W	N/A
PD9533ANMU	07 / 07 /2008	0.130 W	0.110 W	0.110 W	0.068 W	N/A
PD9533ANXMU	07 / 18 /2008	0.470 W	0.048 W	0.048 W	0.436 W	0.211 W
PD9512ANHU	12 / 11 /2008	0.072 W	0.045 W	0.071 W	0.062 W	N/A
PD9533ANHU	12 / 04 /2008	0.438 W	0.045 W	0.045 W	0.441 W	N/A
PD9512ANXMU	11 / 03 /2008	0.632 W	0.048 W	0.047 W	0.338 W	0.242 W
PD9512ANXHU	12 / 09 /2008	0.585 W	0.047 W	0.048 W	0.328 W	0.254 W
TX2-RTL8191SE-L	02 / 25 /2009	0.0667W	N/A	N/A	N/A	N/A
PD9112BNHU	06 / 04 /2009	0.048 W	N/A	N/A	N/A	N/A

New co-located WLAN/WiMAX transmitter devices to be added in this Class II application

**Table-5:** WLAN & WiMAX Antenna Gains of new host PC devices

	Antenna Manufacturer	Main Antenna					Auxiliary antenna				3rd antenna				
		Frequency band (GHz)						Frequency band (GHz)				Frequency band (GHz)			
		2.4 -2.5	5.15 -5.35	5.47 -5.725	5.725 -5.85	WiMAX 2.49-2.69	2.4 -2.5	5.15 -5.35	5.47 -5.725	5.725 -5.85	2.4 -2.5	5.15 -5.35	5.47 -5.725	5.725 -5.85	
T400/R400	NISSEI	0.54	0.90	1.93	1.47	0.67	1.80	-0.17	0.46	0.46	1.99	0.97	0.67	1.29	
	Amphenol	1.47	0.26	-0.36	-0.30	1.94	1.68	1.65	1.58	1.08	-0.60	1.78	2.79	2.46	
	FOXCONN	-0.40	2.59	1.62	1.38	N/A	1.10	1.22	0.00	-0.69	1.85	0.70	0.20	-0.42	
T500/W500	NISSEI	1.35	1.76	0.09	-1.66	1.55	1.99	0.77	2.04	2.42	1.97	0.20	0.82	-1.01	
	Amphenol	1.61	0.75	1.75	1.75	1.32	1.57	1.47	1.73	2.33	1.18	1.53	0.84	0.67	

**Annex-1:** FCC ID:VV7-MBMF3507G-L, FCC Regulatory Compliance History

1. Section 2.933 Change in Identification filing based upon VV7-MBMF3507G

- a. Change in identification grant date:04/30/2008
- b. Output power : Based upon VV7-MBMF3507G (original device)

FCC Rule Parts	Frequency Range (MHZ)	Output Watts/Peak –Grant entries	Actual Peak Output power based upon the test report	Actual Bust-Averaged Power based upon the test report	Modulation
24E	1850.2 - 1909.8	0.871	0.871	0.851	GPRS/10
24E	1850.2 - 1909.8	0.742	0.742	0.617	EDGE/10
24E	1852.4 - 1907.6	0.387	0.524	0.191(RMS)	HSUPA
22H	824.2 - 848.8	2.0	1.995	1.908	GPRS/10
22H	824.2 - 848.8	1.259	1.259	0.617	EDGE/10
22H	826.4 - 846.6	0.435	0.499	0.203(RMS)	HSUPA

MPE Calculation as documented in VV7-MBMF3507G  
 850 MHz frequency band

Maximum output power considerations:

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	33,00	1995,26	25%	498,82
EDGE	31,00	1258,93	25%	314,73
WCDMA	23,62	230,14	100%	230,14
HSDPA	23,49	223,36	100%	223,36
HSUPA	23,08	203,24	100%	203,24

1900 MHz frequency band

Maximum output power considerations:

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	29,30	851,14	25%	212,78
EDGE	28,70	741,31	25%	185,33
WCDMA	22,80	190,55	100%	190,55
HSDPA	23,00	199,53	100%	199,53
HSUPA	22,80	190,55	100%	190,55

2. Class II permissive change, Grant date :05/09/2008

- a. Implementing Two-Way bios lock logic and qualified for portable hosts / (ThinkPad T400/R400 and ThinkPad T500/W500 Laptop Computers).
- b. Highest SAR values: Part 22, 0.173W/kg.; Part 24, 0.112W/kg.

3. Class II permissive change, Grant date: 05/16/2008
  - a. Adding alternate WWAN antenna and co-located with Bluetooth (FCC ID:MCLJ07H081 and FCC ID: QDS-BRCM1033) in Mobile Hosts (MP1, KD1, KD2, and BX3)
4. Class II permissive change, Grant date: 07/18/2008
  - a. Enabling WWAN and WLAN to transmit simultaneously
  - b. Co-located with WLAN modules (FCC ID:PPD-AR5BHB63-L; PD9LEN512ANMU; and PD9533ANMU) in Mobile Hosts (ThinkPad X200/X200s; ThinkPad X300/X301, ThinkPad SL310/400 and SL500).
5. Class II permissive change, Grant date:07/29/2008
  - a. Installed WWAN module in Portable Tablet Computer (ThinkPad X200 Tablet) and co-located with Bluetooth (FCC ID: QDS-BRCM1033)
  - b. Highest SAR values: Part 22, 0.173W/kg.; Part 24, 0.112W/kg.
6. Class II permissive change, Grant date: 08/05/2008
  - a. Enable Simultaneously WLAN and WWAN simultaneously transmission in hosts (ThinkPad **T400/R400** and ThinkPad **T500/W500** Laptop Computers).
  - b. and co-located with Bluetooth (FCC ID: QDS-BRCM1033) and WLAN (FCC ID: PD9LEN512ANMU or FCC ID: PPD-AR5BHB63-L)
7. Class II permissive change, Grant date: 09/17/2008
  - a. Add new co-located WLAN/WiMAX module (FCC ID: PD9533ANXMU) in the mobile Hosts (ThinkPad X200/X200s; ThinkPad X300/X301, ThinkPad SL310/400 and SL500).
8. Class II permissive change, Grant date: 10/16/2008
  - a. Add new co-located WLAN/WiMAX module (FCC ID:PD9533ANXMU) in the portable host (ThinkPad **T400/R400** and ThinkPad **T500/W500** Laptop Computers).
9. Class II permissive change, Grant date: 03/20/2009
  - a. Enable simultaneously WLAN/WiMAX/WWAN transmission in Tablet Computer (ThinkPad X200 Tablet) and co-located with WLAN/WiMAX module (FCC ID:PD9533ANXMU), WLAN modules (FCC ID:PD9LEN512ANMU, FCC ID: PD9533ANMU or FCC ID: PPD-AR5BHB63-L) and Bluetooth Module (FCC ID:MCLJ07H081).
10. Class II permissive change, Grant date: 04/27/2009
  - a. Enable simultaneously WLAN/WiMAX/WWAN transmission in a new Mobile Host (ThinkPad T400s).
  - b. Co-located with FCC ID: PD9533ANHU, FCC ID: PD9512ANHU, FCC ID: PD9512ANXMU, FCC ID: PD9533ANHMU, FCC ID: TX2-RTL8191SE for both Mobile and Portable hosts.
11. Class II permissive change, Grant date: 06/15/2009
  - a. Add new co-located WLAN module (FCC ID: TX2-RTL8191SE-L) in Tablet Computer (ThinkPad X200 Tablet).
12. Class II permissive change, Pending application : (June, 2009)
  - a. Adding alternate WWAN antenna and co-located with Bluetooth (FCC ID: QDS-BRCM 1046) in Mobile Hosts (L410, SL410, L510, SL510).
  - b. Add new co-located WLAN module (FCC ID: PD9112BNHU) in the Portable host (ThinkPad T400/R400 and ThinkPad T500/W500 Laptop Computers) and the Mobile



host (ThinkPad X200/X200s, ThinkPad X300/X301, ThinkPad T400s, ThinkPad SL300/  
SL400/SL500, ThinkPad L410/SL410/L500 and SL510 Laptop Computers).