RF Exposure Evaluation Report

APPLICANT	:	**Nokia Shanghai Bell Co., Ltd.**
EQUIPMENT	:	**Nokia WiFi Beacon 2**
BRAND NAME	:	**Nokia**
MODEL NAME	:	**Beacon 2**
FCC ID	:	**2ADZRBEACON2**
STANDARD	:	**47 CFR Part 2.1091**
		FCC KDB 447498 D01 v06

We, Sporton International (Kunshan) Inc., would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and FCC KDB 447498 D01 v06, and pass the limit. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

Rose Wang

Reviewed by: Rose Wang / Supervisor

Kat Yin

Approved by: Kat Yin / Manager

ACCREDITED Cert #5145.02

Sporton International (Kunshan) Inc.
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA093003	Rev. 01	Initial issue of report	Dec. 07, 2020

1. Administration Data

1.1. Testing Laboratory

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory		
Test Firm	Sporton International (Kunshan) Inc.	
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958	
Test Site No.	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CN1257	314309

Applicant	
Company Name	Nokia Shanghai Bell Co., Ltd.
Address	No.388, Ningqiao Rd, Pilot Free Trade Zone Shanghai, 201206 P. R. China

Manufacturer	
Company Name	Nokia Shanghai Bell Co., Ltd.
Address	No.388, Ningqiao Rd, Pilot Free Trade Zone Shanghai, 201206 P. R. China

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	Nokia WiFi Beacon 2
Brand Name	Nokia
Model Name	Beacon 2
FCC ID	2ADZRBEACON2
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3GHz Band: 5250 MHz ~ 5350 MHz WLAN 5.5GHz Band: 5470 MHz ~ 5730 MHz WLAN 5.8GHz Band: 5725 MHz ~ 5850 MHz
Mode	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 WLAN 5GHz 802.11ax HE20/HE40/HE80
Antenna Type	Dipole Antenna
Antenna Gain	**<For CDD Mode >** <Ant1> WLAN 2.4GHz: Gain: 2.9 dBi WLAN 5.2GHz: Gain: 2.5 dBi WLAN 5.3GHz: Gain: 2.0 dBi WLAN 5.5GHz: Gain: 2.9 dBi WLAN 5.8GHz: Gain: 2.7 dBi <Ant2> WLAN 2.4GHz: Gain: 2.8 dBi WLAN 5.2GHz: Gain: 2.5 dBi WLAN 5.3GHz: Gain: 2.6 dBi WLAN 5.5GHz: Gain: 2.9 dBi WLAN 5.8GHz: Gain: 2.1 dBi **<For Beamforming Mode >** Beamforming Gain : 5.86 dB for WLAN 2.4GHz Beamforming Gain : 5.51 dB for WLAN 5.2GHz Beamforming Gain : 5.32 dB for WLAN 5.3GHz Beamforming Gain : 5.91 dB for WLAN 5.5GHz Beamforming Gain : 5.42 dB for WLAN 5.8GHz
HW Version	V1.0
SW Version	3FE49334
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. WLAN2.4/5GHz beamforming are all supported.
3. For WLAN SISO & MIMO mode, the whole testing has assessed only MIMO mode by referring to the higher conducted power.
4. WLAN2.4 GHz/5 GHz supported 802.11ax full and partial, we only chose full tune up power to perform MPE calculation conservatively.
5. For WLAN CDD & Beamforming mode,the MPE calculation performed separately.
6. The Beamforming gain calculation is reference KDB 662911.
7. There are two types of EUT: sample 1and sample 2, with the same maximum tune up power, the differences between two samples are only for antenna gain value, sample 1 is higher gain compared to sample 1, so always using sample 1 to evaluate MPE calculation.

3. Maximum RF average output power among production units

<For CDD Mode>

<WLAN 2.4GHz>

Mode		Maximum Average Power (dBm) MIMO
2.4GHz	802.11b	30.00
	802.11g	30.00
	802.11n-HT20	29.00
	802.11n-HT40	26.00
	802.11ax-HE20	29.00
	802.11ax-HE40	25.00

Note: WLAN2.4GHz all support SISO/MIMO(2x2) mode, we only chose MIMO(2x2) tune up power to perform MPE calculation conservatively for MIMO(2x2) power is higher than SISO mode.

<WLAN 5GHz>

Mode		Maximum Average Power (dBm) MIMO
5.2GHz	802.11a	27.00
	802.11n-HT20	26.00
	802.11n-HT40	27.00
	802.11ac-VHT20	26.00
	802.11ac-VHT40	27.00
	802.11ac-VHT80	17.00
	802.11ax-HE20	27.00
	802.11ax-HE40	25.00
	802.11ax-HE80	18.00
5.3GHz	802.11a	21.00
	802.11n-HT20	21.00
	802.11n-HT40	24.00
	802.11ac-VHT20	21.00
	802.11ac-VHT40	24.00
	802.11ac-VHT80	18.00
	802.11ax-HE20	22.00
	802.11ax-HE40	24.00
	802.11ax-HE80	17.00
5.5GHz	802.11a	22.00
	802.11n-HT20	21.00
	802.11n-HT40	23.00
	802.11ac-VHT20	21.00
	802.11ac-VHT40	23.00
	802.11ac-VHT80	24.00
	802.11ax-HE20	22.00
	802.11ax-HE40	24.00
	802.11ax-HE80	25.00
5.8GHz	802.11a	29.00
	802.11n-HT20	30.00
	802.11n-HT40	30.00
	802.11ac-VHT20	21.00
	802.11ac-VHT40	29.00
	802.11ac-VHT80	27.00
	802.11ax-HE20	29.00
	802.11ax-HE40	29.00
	802.11ax-HE80	27.00

Note: WLAN5GHz all support SISO/MIMO(2x2) mode, we only chose MIMO(2x2) tune up power to perform MPE calculation conservatively for MIMO(2x2) power is higher than SISO mode.

<For Beamforming Mode>

<WLAN 2.4GHz>

Mode		Maximum Average Power (dBm) MIMO
2.4GHz	802.11n-HT20	25.00
	802.11n-HT40	21.00
	802.11ax-HE20	22.00
	802.11ax-HE40	19.00

Note: WLAN2.4GHz all support SISO/MIMO(2x2) mode, we only chose MIMO(2x2) tune up power to perform MPE calculation conservatively for MIMO(2x2) power is higher than SISO mode.

<WLAN 5GHz>

Mode		Maximum Average Power (dBm) MIMO
5.2GHz	802.11n-HT20	19.00
	802.11n-HT40	20.00
	802.11ac-VHT20	19.00
	802.11ac-VHT40	20.00
	802.11ac-VHT80	11.00
	802.11ax-HE20	20.00
	802.11ax-HE40	19.00
	802.11ax-HE80	11.00
5.3GHz	802.11n-HT20	15.00
	802.11n-HT40	17.00
	802.11ac-VHT20	14.00
	802.11ac-VHT40	17.00
	802.11ac-VHT80	13.00
	802.11ax-HE20	14.00
	802.11ax-HE40	17.00
	802.11ax-HE80	12.00
5.5GHz	802.11n-HT20	15.00
	802.11n-HT40	17.00
	802.11ac-VHT20	15.00
	802.11ac-VHT40	17.00
	802.11ac-VHT80	18.00
	802.11ax-HE20	16.00
	802.11ax-HE40	17.00
	802.11ax-HE80	18.00
5.8GHz	802.11n-HT20	24.00
	802.11n-HT40	24.00
	802.11ac-VHT20	24.00
	802.11ac-VHT40	24.00
	802.11ac-VHT80	22.00
	802.11ax-HE20	24.00
	802.11ax-HE40	24.00
	802.11ax-HE80	23.00

Note: WLAN5GHz all support SISO/MIMO(2x2) mode, we only chose MIMO(2x2) tune up power to perform MPE calculation conservatively for MIMO(2x2) power is higher than SISO mode.

4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f2)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

5. Radio Frequency Radiation Exposure Evaluation

5.1. Standalone Power Density Calculation

<For CDD Mode>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (mW/mW^2)	Limit (mW/mW^2)	Power Density / Limit
WLAN 5.2GHz	5180.0	2.50	27.00	29.500	0.891	891.251	0.177	1.000	0.177
WLAN 5.3GHz	5260.0	2.60	24.00	26.600	0.457	457.088	0.091	1.000	0.091
WLAN 5.5GHz	5500.0	2.90	25.00	27.900	0.617	616.595	0.123	1.000	0.123
WLAN 5.8GHz	5745.0	2.70	30.00	32.700	1.862	1862.087	0.371	1.000	0.371
WLAN 2.4GHz	2412.0	2.90	30.00	32.900	1.950	1949.845	0.388	1.000	0.388

<For Beamforming mode>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (mW/mW^2)	Limit (mW/mW^2)	Power Density / Limit
WLAN 5.2GHz	5180.0	5.51	20.00	25.510	0.356	355.631	0.071	1.000	0.071
WLAN 5.3GHz	5260.0	5.32	17.00	22.320	0.171	170.608	0.034	1.000	0.034
WLAN 5.5GHz	5500.0	5.91	18.00	23.910	0.246	246.037	0.049	1.000	0.049
WLAN 5.8GHz	5745.0	5.42	24.00	29.420	0.875	874.984	0.174	1.000	0.174
WLAN 2.4GHz	2412.0	5.86	25.00	30.860	1.219	1218.990	0.243	1.000	0.243

Note:

1. For conservativeness, the lowest uplink frequency of each band is used to determine the MPE limit of that band.
2. Chose the maximum power to do MPE analysis.
3. WLAN2.4/5GHz beamforming are all supported.
4. The Beamforming gain calculation is reference KDB 662911.

5.2. Collocated Power Density Calculation

<For CDD Mode>

WLAN 2.4GHz Power Density / Limit	WLAN 5GHz Power Density / Limit	Σ(Power Density / Limit) of WLAN2.4GHz +WLAN5GHz
0.388	0.371	0.759

< For Beamforming mode>

WLAN 2.4GHz Power Density / Limit	WLAN 5GHz Power Density / Limit	Σ(Power Density / Limit) of WLAN2.4GHz +WLAN5GHz
0.243	0.174	0.417

Note:

1. Σ(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WLAN 2.4GHz + WLAN 5GHz.
2. Considering the WLAN 2.4GHz collocation with the WLAN 5GHz transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 2 collocated transmitters is compliant.

Conclusion:

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.