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APPLICATION NOTE

How to extend the wireless range

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V1.1	10/01/2014	Maxime Obr.	First version of the document
V1.2	20/12/2018	Youssef Shahine	New antennas references
V1.3	21/12/2020	Seddik ATTIG	Which kind of antenna you should select

Contents

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1. TECHNICAL SUPPORT

For general contact, technical support, to report documentation errors and to order manuals, contact ***BeanAir Technical Support Center*** (BTSC) at:
tech-support@beanair.com

For detailed information about where you can buy the BeanAir equipment/software or for recommendations on accessories and components visit:

www.beanair.com

To register for product news and announcements or for product questions contact BeanAir's Technical Support Center (BTSC).

Our aim is to make this user manual as helpful as possible. Please keep us informed of your comments and suggestions for improvements. BeanAir appreciates feedback from the users.

2. VISUAL SYMBOLS DEFINITION

Visual	*Definition*
	***Caution or Warning** – Alerts the user with important information about BeanAir wireless sensor networks (WSN), if this information is not followed, the equipment /software may fail or malfunction.*
	***Danger** – This information MUST be followed if not you may damage the equipment permanently or bodily injury may occur.*
	***Tip or Information** – Provides advice and suggestions that may be useful when installing BeanAir Wireless Sensor Networks.*

3. ACRONYMS AND ABBREVIATIONS

AES	Advanced Encryption Standard
CCA	Clear Channel Assessment
CSMA/CA	Carrier Sense Multiple Access/Collision Avoidance
GTS	Guaranteed Time-Slot
kSps	Kilo samples per second
LLC	Logical Link Control
LQI	Link quality indicator
LDCDA	Low duty cycle data acquisition
MAC	Media Access Control
PAN	Personal Area Network
PER	Packet error rate
RF	Radio Frequency
SD	Secure Digital
SSD	Smart shock detection
WSN	Wireless sensor Network

4. SOME DEFINITIONS

Directional Antenna: A Directional antenna is an antenna which radiates greater power in one or more directions allowing for increased performance on transmit and receive and reduced interference from unwanted sources

Omnirectional Antenna: An omnidirectional antenna is an antenna system which radiates power uniformly in one plane with a directive pattern shape in a perpendicular plane. This pattern is often described as "donut shaped".

Line of Sight (LOS): Line-of-sight is an unobstructed path between transmitting and receiving antennas

Beamwidth: In the radio regime, of an antenna pattern, the angle between the half-power (-3 dB) points of the main lobe, when referenced to the peak effective radiated power of the main lobe.

Signal-to-noise ratio: (often abbreviated SNR or S/N) is a measure used in science and engineering to quantify how much a signal has been corrupted by noise. It is defined as the ratio of signal power to the noise power corrupting the signal. A ratio higher than 1:1 indicates more signal than noise.

5. EARTH'S CURVATURE

In Long Range application, one antenna may not "see" another because of the earth's curvature. Two antennas are shown each having the same height. Line-of-sight transmission means the transmitting and receiving antennae can "see" each other as shown. The maximum distance at which they can see each other, occurs when the sighting line just grazes the earth's surface.

Figure 1: Earth's curvature

6. HOW TO OPTIMIZE THE WIRELESS RANGE

- ✓ Use the Maximum TX Power on your BeanDevice®. You can easily configure the TX Power on your BeanDevice® from your BeanScape® 2.4GHz WSN software supervision;
- ✓ Try to configure your receiver antenna and your transmitter antenna on the same antenna pattern (cf. the Beamwidth of your antenna);
- ✓ Use a high gain antenna (in outdoor use only) for a better RF Link Budget. If BeanDevice® are located in the same area use a high gain directional antenna. Compared to omnidirectional antenna, a directional antenna increases the signal strength by positioning the main lobe in the desired direction;
- ✓ Mount your BeanDevice® 2.4GHz & BeanGateway® 2.4GHz on a top of a mast or a building;

6.1 HIGH GAIN DIRECTIONAL ANTENNA

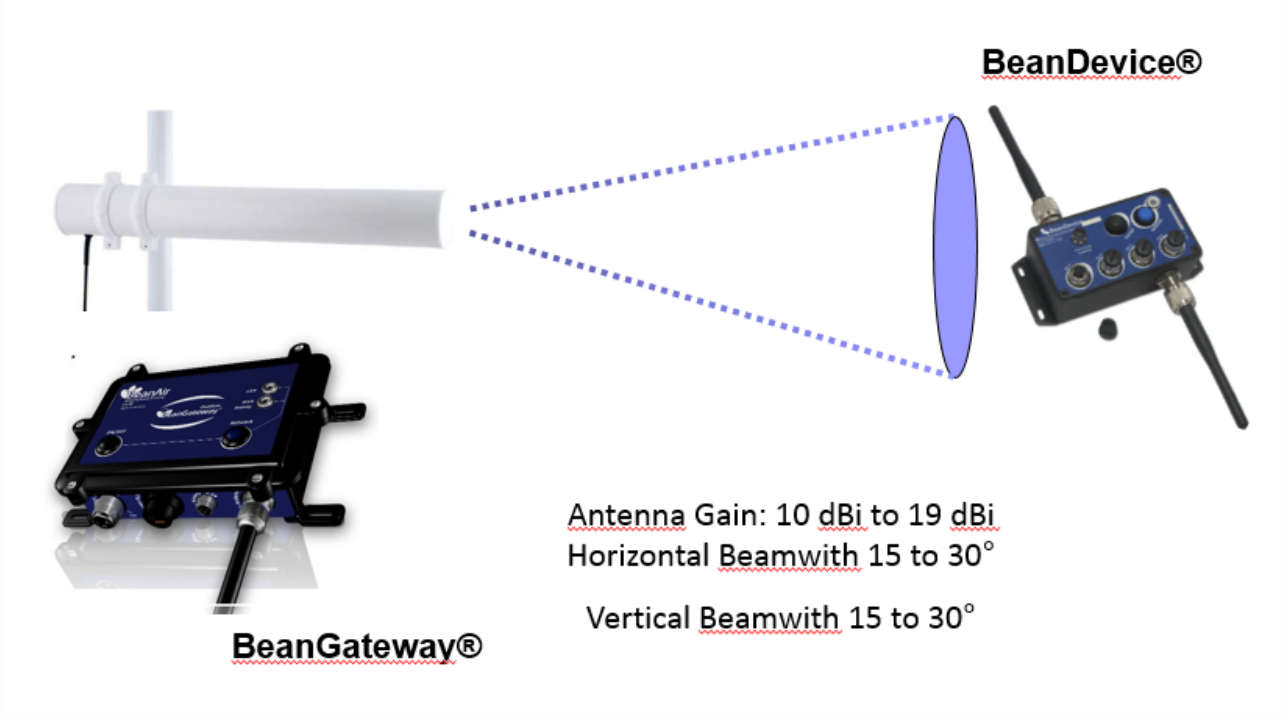

Figure 2 : High gain directional antenna

6.2 OMNIDIRECTIONAL ANTENNA

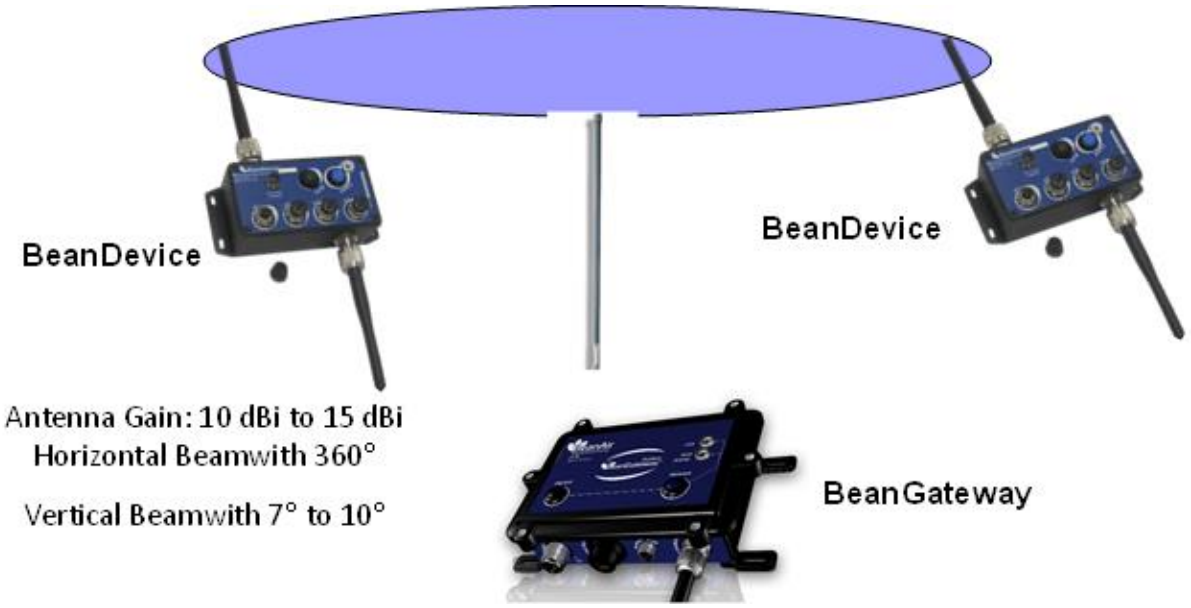

Figure 3 : High gain omnidirectional antenna

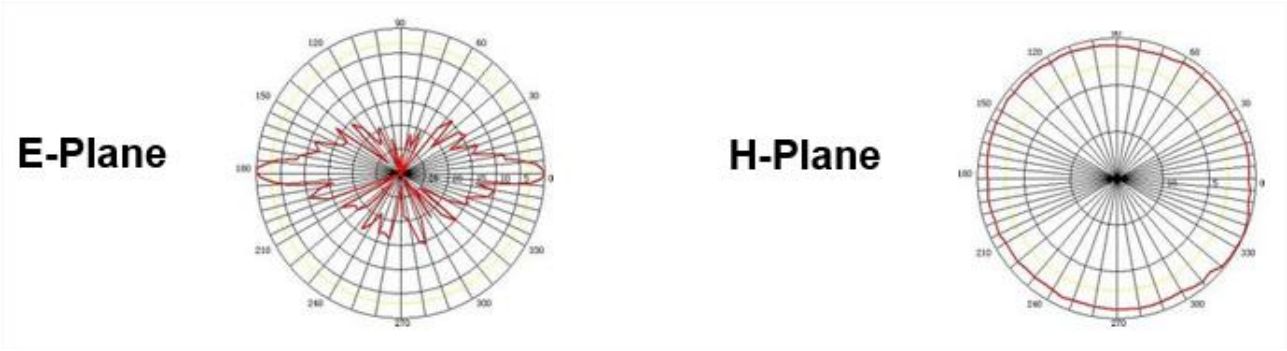

Figure 4 : Antenna pattern - directional antenna

7. ANTENNA OPTIONS PROVIDED BY BEANAIR

7.1 OMNIDIRECTIONAL ANTENNA

Product Description	Products concerned	Picture (for illustration purposes only)	Ref
Omnidirectional antenna 5.5 dbi for indoor use only ***Main features :*** Freq Range 2400 - 2485 MHz Gain @ 2400 MHz 5.5 dBi Ver Beamwidth : 90° Deg Hor Beamwidth : 360° Deg VSWR : 1.5:1 Impedance : 50 Ohm Input Power: 10 W Operating Temp: -10 +60 Deg C Connector: SMA Male Weight: 26 gr Dimensions: 210 x 10D mm	**BeanGateway Indoor**		HG_OMNI_5_5_DBI
Omnidirectional antenna 9dBi for indoor use only ***Main features :*** Freq Range 2400 2485 MHz Gain @ 2400 MHz 9 dBi Ver Beamwidth 90° Hor Beamwidth 360° VSWR 1.5:1 Impedance 50 Ohm Input Power 10 W Operating Temp -10 +60 Deg C Connector RP-SMA Plug Weight 60 gr Dimensions 380 x 10D mm	**BeanGateway Indoor**		HG_OMNI_9_DBI
Omnidirectional antenna 5dBi for outdoor use ***Main Features :*** Waterproof design Outoor use Professional N-type design reduces stress N-type, Male, Reverse Polarity, VSWR < 2.0 Length=95mm wind survival: up to 180Mph Watertight IP65	***BeanGateway Outdoor version BeanDevice AN-V/ AN-420/ AN-mV***		HG_OMNI_5_OUT_DBI

High Gain Omnidirectional antenna ***Main features:*** Frequency range 2400-2500MHz Gain 7 dBi, VSWR < 1.4 Impedance 50 Ohm, Polarization Vertical Vertical plane 24°, Horizontal plane 360° Protection DC Grounded Dimensions 360mm x 23mm, Weight 0.44 kg Connector N female, Wind load (170km/h) 7.3N ---------- **Included:** 1 x N-Type cable (Male/Male), length: 1 meter	***BeanGateway Outdoor version BeanDevice AN-V/ AN-420/ AN-mV***		HG-OMNI-OUT-7DBI	35	40
High Gain Omnidirectional antenna ***Main features:*** Frequency range 2400-2500MHz Gain 9dBi, VSWR < 1.2 Impedance 50 Ohm, Polarization Vertical Vertical plane 15°, Horizontal plane 360° Protection shorted for DC, Dimensions 540x23 mm Weight 0.61 kg, Connector N female Wind load (170km/h) 11 N **Included:** 1 x N-Type cable (Male/Male), length: 1 meter	***BeanGateway Outdoor version BeanDevice AN-V/ AN-420/ AN-mV***		HG-OMNI-OUT-9DBI	45	51
High Gain Omnidirectional antenna ***Main features:*** Frequency range 2400-2500MHz Gain 12dBi, VSWR < 2.0 Impedance 50 Ohm, Polarization Vertical Vertical plane 6°, Horizontal plane 360° Protection shorted for DC, Dimensions 1123x23 mm Weight 1.15 kg, Connector N female, Wind load (170km/h) 11 N **Included:** 1x N-Type cable (Male/Male), length: 1 meter	***BeanGateway Outdoor version***		HG-OMNI-OUT-12DBI	65	74

7.2 DIRECTIONAL ANTENNA

High Gain Panel Directional antenna for outdoor use ***Main features :*** Frequency range: 2400-2500MHz, Gain: 17 dBi VSWR < 1.5, Impedance: 50 Ohm Polarization: Horizontal or Vertical Vertical plane: 20°, Horizontal plane: 20° Front to back ratio > 35 dBi Dimensions 315 x 315 x 15mm, Weight 1.42kg Connector N female, Wind load (170km/h) 129.0 N **Included:** 1 x N-Type cable (Male/Male), length: 1 meter	**BeanGateway Outdoor version**	

8. WHICH KIND OF ANTENNA YOU SHOULD USE

For each application case, you should select the right antenna which match your application needs.

- If your BeanDevices® are concentrated on the same area, and all the signals are coming from one direction you should go for the **directional antenna**, and here the antenna and the BeanDevices® need to be pointed towards each other in order to receive the best possible signal.

- If your BeanDevices® are spread everywhere and in all directions along a plane, you should use the **Omnidirectional antenna**.

https://www.beanair.com/files/HIGH-GAIN-ANTENNA-OMNI-7DBI-SPECS.pdf

https://www.beanair.com/files/HIGH-GAIN-ANTENNA-OMNI-9DBI-SPECS.pdf

Higher is the gain, narrower the beamwidth on the vertical plane