Grandstream Networks, Inc.

GWN7672WM - Antenna Radiation Patterns

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Introduction

One of the major components of a wireless Access Point is the antenna. These radio components come in different shapes and sizes to fit specific deployment needs, and each access point can bundle multiple antennas for sending and receiving signals in order to benefit from the MIMO (Multiple Input/Multiple Output) technology and obtain higher throughput and signal resilience, also the arrangement of multiple antennas internally to a single WLAN access point can be used to influence the shape and behavior of the wireless signal (both on transmit and receive). To better understand how each GWN access point model broadcasts the wireless signals, this paper provides radiation patterns to help engineers during the deployment process.

The GWN7672WM is a powerful enterprise-grade BE11000 tri-band Wi-Fi 7 access point, offering 2x2:2 MU-MIMO alongside DL/UL Enhanced OFDMA technology. Featuring a stylish appearance and a paintable exterior, this AP integrates perfectly into any space, matching any unique aesthetic with ease. By supporting core Wi-Fi 7 features, it maximizes network throughput and expands wireless coverage range for demanding environments. This model offers hybrid management flexibility through its local web UI or cloud-based platforms like GDMS Networking and GWN Manager. It is an ideal solution for medium wireless network deployments with medium-to-high user density.

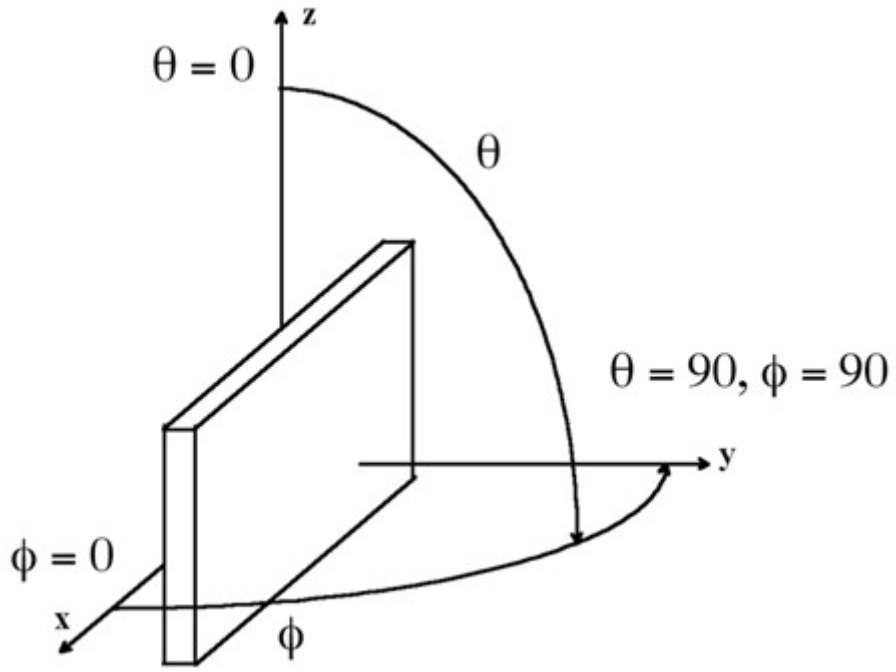
We begin this report with a glossary of basic definitions related to antennas' radio characteristics and then progress through the specific radiation patterns for the GWN7672WM access point series.

Terminology

In this first part, we will provide a quick brief review of some fundamental concepts related to antennas and radio propagation:

Antenna: An antenna is a transducer between a feed signal and radiated wave over the space, it is usually attached to a transmitter/receiver unit and the radiated energy is characterized by the antenna's radiation pattern.

Antenna pattern: The radiation pattern or antenna pattern is the graphical representation of the radiation properties of the antenna and how it radiates energy out into space or how it receives energy (reciprocity). An antenna radiates energy in all directions, at least to some extent, so the antenna pattern is actually three-dimensional. It is common, however, to describe this 3D pattern with planar patterns called the principal plane patterns. These principal plane plots are commonly referred to as antenna radiation patterns.



Polar Coordinates

Isotropic radiator: An isotropic radiator is a hypothetical lossless antenna that radiates its energy equally in all directions. This imaginary antenna would have a spherical radiation pattern and the principal plane cuts would both be circles since any plane cut through a sphere would be a circle.

Gain: The gain of an antenna (in a given direction) is defined as the ratio of the power gain in that direction to the power gain of a reference antenna in the same direction, usually an isotropic radiator is set as reference and the value of the gain is expressed in dBi. It is important to state that an antenna with gain doesn't generate power and it does simply direct the way the radiated power is distributed relative to radiating the power equally in all directions, thus the gain is just a characterization of the way the power is radiated.

Efficiency: The efficiency of an antenna is the ratio of the power delivered to the antenna relative to the power radiated from the antenna. A high-efficiency antenna has most of the power present at the antenna's input radiated away. A low-efficiency antenna has most of the power absorbed as losses within the antenna or reflected away due to impedance mismatch which causes an antenna to not have an efficiency of 100%.

Antenna efficiency losses are typically due to:

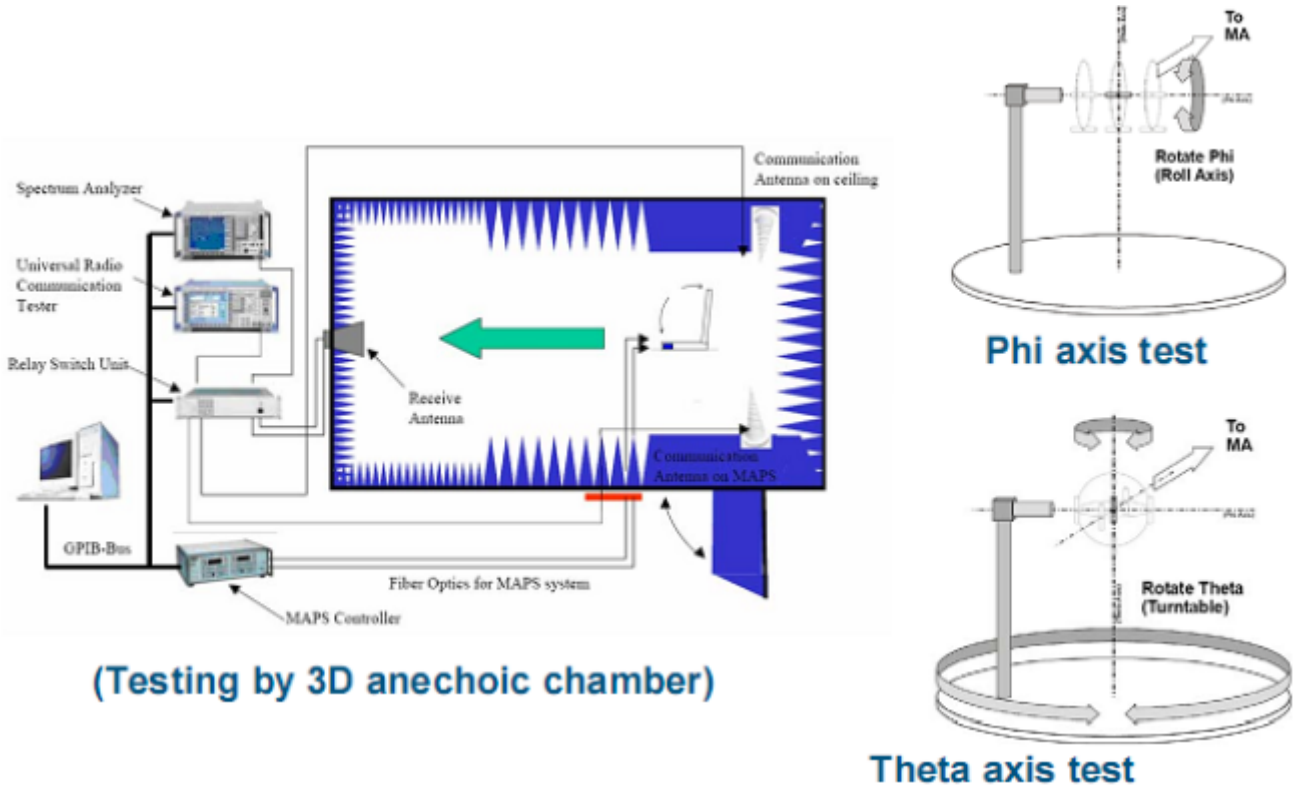
- Conduction losses (due to finite conductivity of the metal that forms the antenna).
- Dielectric losses (due to the conductivity of a dielectric material near an antenna).
- Impedance mismatch loss.

Test environment

This test report gives schematic diagrams with antennas distribution of GWN76XX access points series, along with the antenna radiation patterns of 2.4Ghz, 5Ghz and 6GHz frequencies in order to help engineers during the deployment process.

Please note that these radiation patterns are gathered in a fully anechoic environment. Their shape will change in installed environments depending on the obstacles that the wireless signal might face. Every deployment will behave differently due to materials, geometries of structures, etc, and how these materials behave at 2.4GHz, 5GHz and 6GHz.

The below figure gives an overview of the used test environment:



Test Environment

GWN7672WM Antenna Characteristics

Antenna Patterns

This section presents the antenna radiation patterns of the GWN7672WM access point, based on conducted testing. The measurements are provided across three radiation planes: **XZ (Phi = 0°)** and **YZ (Phi = 90°)**, representing the vertical (elevation) views, and **XY (Theta = 90°)**, representing the horizontal (azimuth) view.

The radiation pattern data covers the following frequency bands:

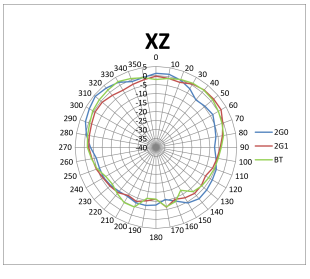
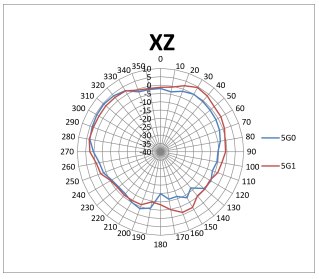
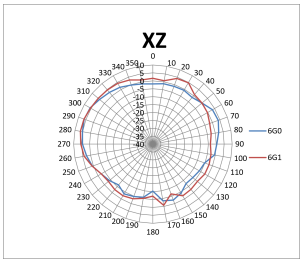
Frequency Bands:

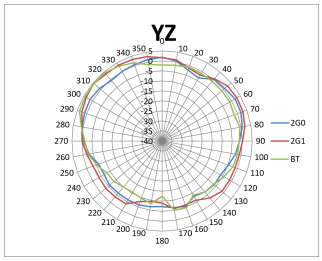
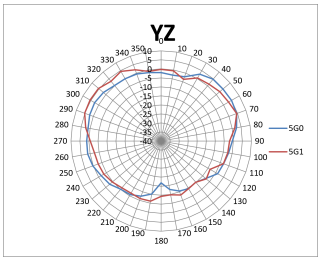
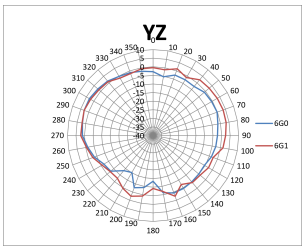
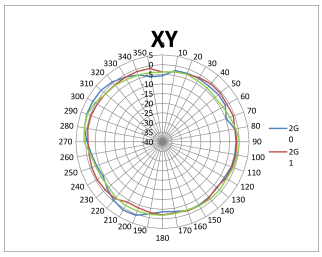
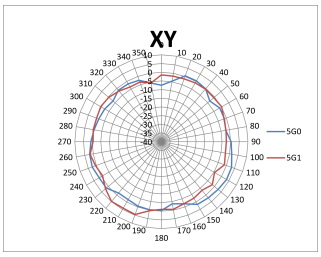
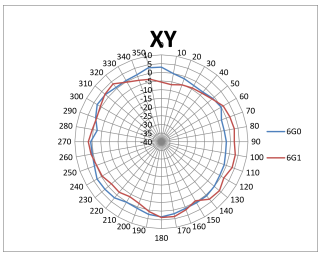
- **2.4 GHz / Bluetooth (2GBT):** Includes measurements for 2G0, 2G1, and BT (Bluetooth).
- **5 GHz:** Includes measurements for 5G0 and 5G1.
- **6 GHz:** Includes measurements for 6G0 and 6G1.

Measurements are recorded at 10° angular intervals, from 0° to 350°, for each frequency band and radiation plane.

Antenna Gain:

For detailed radiation pattern measurements for each frequency band, please refer to the tables below.

Label	2.4G	5G	6G
Phi=0(deg)XZ			

Phi=90(deg)YZ			
Theta=90(deg) XY			

GWN7672WM Antenna Radiation Patterns

2.4 GHz / Bluetooth (2GBT) Radiation Pattern

This section presents the radiation pattern measurements for the 2.4 GHz Wi-Fi bands (2G0 and 2G1) and Bluetooth (BT). The data covers three radiation planes (XZ, YZ, and XY), providing measurements at 10° angular intervals from 0° to 350°.

Angle (°)	XZ - 2G0	XZ - 2G1	XZ - BT	YZ - 2G0	YZ - 2G1	YZ - BT	XY - 2G0	XY - 2G1	XY - BT
0	1.2	-0.4	-2.2	1.8	1.6	-2.1	-5.8	-3.8	-3.9
10	1.3	-1	-1.1	0.5	1	-1.6	-2.5	-3.3	-3.2
20	-0.2	-1.5	0.2	-2.3	-1.2	-0.8	-2.3	-2.7	-2.8
30	-2.4	0.6	1.2	-3.7	-2.1	-1	-2.2	-1.7	-3.5
40	-5.5	1.7	1.5	0.2	0.6	-1.1	-2.4	-0.9	-3.8
50	-4.4	1.9	1.1	0.8	2.6	-1.1	-2	-0.8	-4.3
60	-3.5	1.8	0.1	2	3.1	-1	-2.2	-1.3	-3.8
70	-5.2	-0.5	-0.9	1.8	2.9	-1.7	-4.8	-0.8	-2.7
80	-6.1	-2.5	-1.8	0.6	1.9	-0.6	-1.8	-1.8	-1.3
90	-7.4	-4.2	-3.7	-1.4	0.1	-1.5	-1.7	-1.2	0.1
100	-6.2	-5.5	-4.8	-2.8	-0.9	-1.8	-1.8	-1.4	-0.5
110	-4.3	-6.5	-5.4	-4.8	-1.2	-2.4	-1.9	-1.5	-0.8
120	-3.8	-8.2	-6.2	-6.3	-1.1	-4.3	-2.9	-2	-1.5
130	-3.2	-7.1	-6.8	-6.1	-1	-6.5	-2.9	-3.3	-1.2
140	-2.8	-6.6	-7.9	-6.8	-2.9	-6.8	-2.5	-2.2	-1.3
150	-4.4	-7.7	-12.5	-8.2	-6	-8.9	-2	-1.7	-1.7
160	-8.3	-9.3	-8.1	-5.5	-6.1	-4.6	-2.2	-2	-2.4
170	-10.6	-6.3	-6.5	-6.2	-5.7	-4.9	-3.3	-2.5	-2.2
180	-7.9	-11.2	-11.3	-7.3	-9	-12.5	-3.7	-2.1	-1.9
190	-7.2	-9.8	-11.2	-6.7	-9.4	-8.3	-2	-2.8	-1.8
200	-7.3	-8	-4.8	-6.1	-7.9	-9.7	0.5	-3.5	-1.7

210	-8.5	-9.2	-4.6	-6.1	-3.9	-10.5	0.9	-3.8	-1.8
220	-8.1	-7.2	-6.5	-6.1	-3.6	-10.1	-0.5	-1.6	-2.3
230	-7.1	-6.6	-8.3	-5.8	-3.4	-8.6	-2.5	-1.2	-3.5
240	-6.4	-6	-7.7	-6.7	-3.7	-8.2	-4.4	-0.8	-3.3
250	-6.5	-4.7	-5.2	-6.3	-3.4	-5.3	-3.6	-0.9	-3.1
260	-6.2	-3.8	-3.6	-3	-1.9	-2.5	-2.6	-1.3	-2.1
270	-3.5	-2.5	-1.8	-0.9	-0.1	-1.4	-0.8	-1.3	0.8
280	-0.7	-2.3	-1.3	0.5	0.6	0.9	1.2	-0.6	1.2
290	1.8	-1.9	-0.7	1.1	2.6	3.8	1.8	-0.4	1.5
300	2.9	-0.8	0.6	1.5	3.7	4.3	1.8	-0.9	0.4
310	4.14	-0.9	1.2	0.8	4.51	4.48	1.6	-1.3	-1.5
320	3.1	-2.2	1.7	-0.6	3.6	4.4	0.5	-1.5	-1.8
330	1.8	-3.3	2.2	0	3.6	3.1	-1.3	-1.4	-2.7
340	-1	-2.6	0.8	0.5	3.3	1.5	-3.2	-1.3	-3.2
350	-0.5	-1.8	-0.7	1.2	2.7	-1.3	-5.9	-1.5	-3.7

5 GHz Radiation Pattern

This section presents the radiation pattern measurements for the two 5 GHz frequency bands (5G0 and 5G1). Measurements are provided across the XZ, YZ, and XY planes, covering the full 360° angular range at 10° intervals.

Angle (°)	XZ - 5G0	XZ - 5G1	YZ - 5G0	YZ - 5G1	XY - 5G0	XY - 5G1
0	-2.1	-1.3	-2.1	-0.3	-7.5	-1.5
10	-3.5	-0.6	-2.9	-0.5	-4.5	-1.6
20	-1.4	2.2	-2.1	-3.6	0.3	-1.5
30	-0.2	4.5	2.8	0.4	0.5	-0.8
40	-0.6	3.7	4.8	1.2	-0.3	-0.4
50	-1.1	2.1	4.7	2.5	-3.5	-0.5
60	-1.5	1.9	5.06	3.2	-1.1	0.2
70	-2.2	0.9	4.6	4.6	-1.3	-1.5
80	-3.5	-0.6	2.4	1.4	-2.2	-2.1
90	-5.5	-0.9	-0.5	-2.1	0.3	-2.4
100	-5.5	-2.5	-2.1	-2.5	1.3	-2.5
110	-6.8	-3.4	-3.2	-3.3	3.1	-1.2
120	-5.1	-5.8	-3.8	-8.7	3.5	-4.5
130	-5.8	-5.3	-7.8	-7.3	2.7	-1.6
140	-11.8	-5.5	-10.2	-10.2	2.2	-3.5
150	-8.2	-1.5	-9.5	-9.5	1.6	-2.5
160	-11.5	-1.3	-10.5	-8.2	-2	-2
170	-11.2	-4.8	-12.8	-9.8	-3.7	-0.5
180	-14.9	-8.3	-16.8	-9.3	-0.4	-1.1

190	-5.8	-9.5	-10.2	-6.2	-0.3	0.3
200	-3.7	-6.2	-7.5	-6.1	-0.5	4.6
210	-5.2	-6.2	-5.7	-6.6	-1.5	4.1
220	-7.1	-6.1	-5.2	-6.1	-1.5	4.8
230	-7.2	-6.5	-2.8	-4.7	1.5	2.2
240	-6.1	-5.4	-1.6	-3.3	1.5	-0.8
250	-3.5	-1.8	0.3	-2.9	2.5	0.5
260	-2.6	-0.8	1.3	-2.5	2.1	1.9
270	0.3	2.5	1.3	-0.7	0.8	-0.5
280	3.1	3.5	1.1	2.5	-0.5	0
290	3.7	2.9	2.1	5.03	-1.5	-0.2
300	4.2	2.7	2.5	5.47	-2.2	0.5
310	4.5	2.9	1.8	5.3	-3.5	-0.3
320	3.8	2.5	0.2	3.2	-1.3	-1.9
330	2.3	2.1	-0.1	4.52	-1.5	-3.6
340	-1.8	-0.6	-0.5	2.03	-2.3	-3.5
350	-2.1	-1.5	-1.5	-0.8	-5.7	-5.6

6 GHz Radiation Pattern

This section presents the radiation pattern measurements for the two 6 GHz frequency bands (6G0 and 6G1). The measurements cover the XZ, YZ, and XY radiation planes, with recorded values at 10° angular intervals from 0° to 350°.

Angle (°)	XZ - 6G0	XZ - 6G1	YZ - 6G0	YZ - 6G1	XY - 6G0	XY - 6G1
0	-1.9	1.6	-2.8	-0.5	2.9	-5.7
10	-1.2	0.7	-5.3	-1.2	-0.1	-6.6
20	-1.1	4.2	-2.6	1.3	-1.4	-5.2
30	-0.7	4.8	-2.6	-1.1	-2.6	-4.3
40	-1.5	0.8	-2.8	2.3	-2.7	-3.5
50	0.4	0.5	-0.9	2.8	-1.2	-1.7
60	3.4	-0.2	-0.5	3.3	-0.1	1.3
70	3.9	-1.8	-0.2	3.5	-3.1	2.1
80	2.2	-2.6	-1.6	3.3	-3.1	2.8
90	0.4	-3.7	-2.4	2.4	-2.4	2.1
100	-0.5	-2.8	-2.8	1.4	-2.3	3.4
110	-5.3	-2.2	-3.7	-2.7	-1.3	3.5
120	-6.2	-2.2	-5.3	-2.6	-1.1	1.6
130	-7.1	-3.3	-5.1	-4.1	-0.1	3.8
140	-7.5	-2.6	-4.8	-4.3	0.6	3.2
150	-4.4	-2.3	-4.5	-7.1	0.6	-0.7
160	-2.4	-6.5	-4.4	-2.4	0.8	1.7

170	-3.6	-0.7	-6.3	-6.9	2.1	3.7
180	-10.3	-7.1	-13.4	-9.2	3.3	3.6
190	-5.9	-5.2	-9.3	-4.3	2.4	0.8
200	-4.8	-3.2	-7.7	-2.4	0.8	-2.2
210	-3.7	-2.3	-15.2	-4.6	0.2	-3.5
220	-6.3	-2.5	-13.4	-7.6	2.2	-2.1
230	-4.2	-3.3	-7.7	-7.3	2.5	-2.3
240	-2.3	-2.4	-6.8	-5.6	2.9	-0.5
250	0.6	0.7	-3.5	-2.6	1.1	-0.2
260	2.5	4.1	-1.2	-0.5	0.6	1.2
270	4.5	5.5	1.2	2.2	0.9	2.2
280	5.2	6.5	1.9	2.1	-2.3	0.5
290	6.18	6.3	2.8	2.8	0.4	-0.2
300	5.8	5.5	2.9	2.2	2.8	0.7
310	3.9	5.1	2.1	1.3	2.2	2.5
320	2.7	4.7	1.3	0.9	0.8	3.5
330	1.5	4.3	-0.3	-1.4	0.7	-0.4
340	-0.2	3.1	-1.1	-1.6	1.1	-2.3
350	-1.4	1.2	-2.1	-0.6	3.2	-3.5