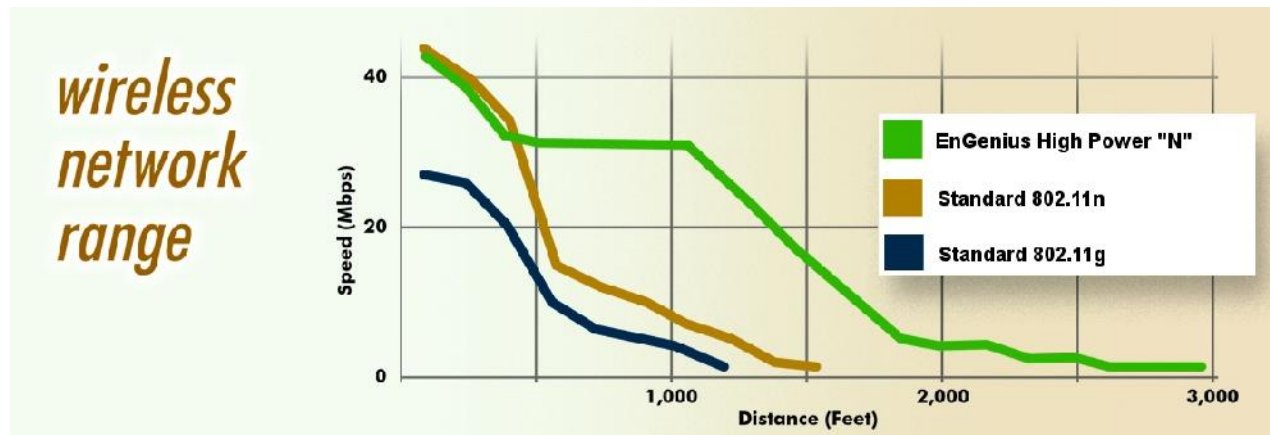


Across-the-Board High Powered 802.11n Wifi Networking



Presenter: Jeriel Tenorio

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Topics

About EnGenius

Key Specifications

- 802.11 Standards
- Understanding 802.11n
- Transmit Power

General Application Models

- Indoor AP
- Wireless Home
- Point to Point Long Range
- Outdoor AP

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About EnGenius

EnGenius® Technologies, Inc. is an industry expert in wireless communications and radio frequency (RF) technology. The company pioneered “Affordable Long-Range Wireless” communication solutions, and creates wireless voice and data products for home, SOHO and SMB use that are versatile, feature-rich, business-class and affordable. Our complete line of award-winning devices is designed to deliver long-range, fast speeds, robust security, and ease-of-use. Established in 1999, EnGenius Technologies, Inc. is a wholly-owned subsidiary of Senao Networks, a Taiwan RF communications manufacturing company.

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WiFi Standards

- 802.11**b**
2.4GHz, 11Mbps throughput, DSSS modulation
- 802.11**a**
5GHz, 54Mbps throughput, OFDM modulation
- 802.11**g**
2.4GHz, 54Mbps throughput, OFDM modulation
- 802.11**n**
2.4GHz and 5GHz, 300Mbps throughput, MIMO and Spatial Multiplexing, 20-40MHz channels

Understanding 802.11n

- Amendments to the previous 802.11 standard
- Significantly improves PHY layer transmission rate over the previous standards with High Throughput (HT) options.
- Increase the MAC layer transfer rate to achieve over 100 Mbps data throughput
- Maintain backward compatibility with legacy 802.11a/b/g

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PHY Layer Improved

- OFDM data sub carriers from 48 to 52 improves throughput from 54 to 58.5 Mbps
- FEC (Forward Error Correction) system in which the sender adds data to allow the receiver to detect and correct errors, boosting link rate to 65 Mbps
- Shorter GI (Guard Interval) between OFDM symbols from 800ns to 400ns increasing throughput to 72 Mbps
- Channel Bonding doubling channel bandwidth from 20MHz to 40MHz more than doubles throughput to 150 Mbps
- Spatial multiplexing, up to 4 spatial streams (MIMO) increases throughput up to 4 times (150 to 600 Mbps)

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New Modulation Coding Scheme

- 802.11b/g selects the highest of 12 possible rates
- 802.11n allows for up to 77 MCS rates
- MCS selected based on RF channel condition, based on 8 data rates, bonded channels, multiple spatial streams, guard intervals, and modulation types
- Multi-streaming modulation, 150 Mbps per spatial stream

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MAC Layer Frame Aggregation

- A-MSDU (Aggregate-MAC Service Data Unit) wraps up to 8 KB multiple Ethernet frames in a 802.11 frame
- A-MPDU (Aggregate-MAC Protocol Data Unit) allows up to 64 KB 802.11 frame bursting
- Block ACK eliminates the need to initiate a new transfer for every MPDU

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MIMO

Commonly referred to as smart antenna technology

Sensitivity to fading is reduced by the spatial diversity provided by multiple spatial paths.

Can provide better range in environments with multi-path issues

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What About Range?

Higher data throughput achieved by adding:

- Phy and MAC layer improvements
- MIMO for Spatial Multiplexing
- 20-40MHz channels
- Can be 2.4GHz or 5GHz

Facts:

“Under the best conditions, many 802.11n routers deliver throughput between 100 Mbps and 120 Mbps near the router. However, speeds degrade quickly to about 45 Mbps in the 300- to 600-foot range”

“The truth about the 802.11n specification is that it does not really increase your wireless coverage area.”

-Quoted from Laptopmag.com

The same RF physics still apply, so the wireless connection will still drop out at the same signal levels.

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Transmit Power

- Tx power is the amount of power a radio transmits
- Generally, the longer the distance, the more power needed
- High transmit power and receive sensitivity means less APs.

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Understanding dBm

- The dBm is an absolute power measurement.
 - The “m” stands for milliwatt, which is the reference point.
 - 0dbm is 1mW of power

1dbm is 1dB stronger than 0dBm or 1dB stronger than 1mW (1.3mW)

0dBm = 1mW -3dBm = 0.5mW 3dBm = 2mW 10dBm = 10mW -10dBm = 0.1mW
28dBm = 600mW (approx.) 30dBm = 1000mW or 1 watt

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dBm to Milliwatts

dBm to Watt Conversion Table

dBm	Watts	dBm	Watts	dBm	Watts
0	1.0 mW	16	40 mW	32	1.6 W
1	1.3 mW	17	50 mW	33	2.0 W
2	1.6 mW	18	63 mW	34	2.5 W
3	2.0 mW	19	79 mW	35	3.2 W
4	2.5 mW	20	100 mW	36	4.0 W
5	3.2 mW	21	126 mW	37	5.0 W
6	4 mW	22	158 mW	38	6.3 W
7	5 mW	23	200 mW	39	8.0 W
8	6 mW	24	250 mW	40	10 W
9	8 mW	25	316 mW	41	13 W
10	10 mW	26	398 mW	42	16 W
11	13 mW	27	500 mW	43	20 W
12	16 mW	28	630 mW	44	25 W
13	20 mW	29	800 mW	45	32 W
14	25 mW	30	1.0 W	46	40 W
15	32 mW	31	1.3 W	47	50 W

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Understanding dBi

- Dbi = The Db gain an antenna has as compared to a baseline “Isotropic radiator” type antenna. It’s simply a reference point.
 - The Isotropic radiator is a theoretical antenna where the signal is transmitted like a globe, equally in all directions.
 - Does not exist in real life. The design of any real antenna will cause the signal to favor one direction (even slightly) over another.
 - The physical laws of the conservation of energy says if you gain power in one direction, the other direction must be lost.
- To have antenna gain therefore means the signal pattern is changed to be favorable in a certain direction over another. The more disproportional it is, the more gain is realized.

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Calculating EIRP

- Dbm and Dbi – You can add or subtract them!
 - Dbm is power while Dbi is antenna gain.
 - The total power (transmitter, losses of cable, gain of antenna etc.) is called EIRP (Equivalent Isotropically Radiated Power)
Example: $28\text{dbm} + (-2\text{db coax loss}) + 6\text{dbi antenna} = 34\text{dbm EIRP}$.
 - FCC limits EIRP for Omni-directional signals to 36dbm for 2.4GHz and 5GHz WiFi
 - For directional signals, for every 3db of antenna gain beyond 6dbi, transmitter power must be reduced by 1dbm.
 $26\text{dbm} + 6\text{dbi} = 32\text{dbm EIRP}$

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Up to 400mW Tx Power N Mode

- The typical leading brand AP has a Tx power of 17dBm or 50mW
Rule of thumb:
Outdoors - for every increase of 6 dB, the coverage distance doubles.
Indoors - for every increase of 9 dB, the coverage area doubles.
- EAP300 transmit power and receive sensitivity

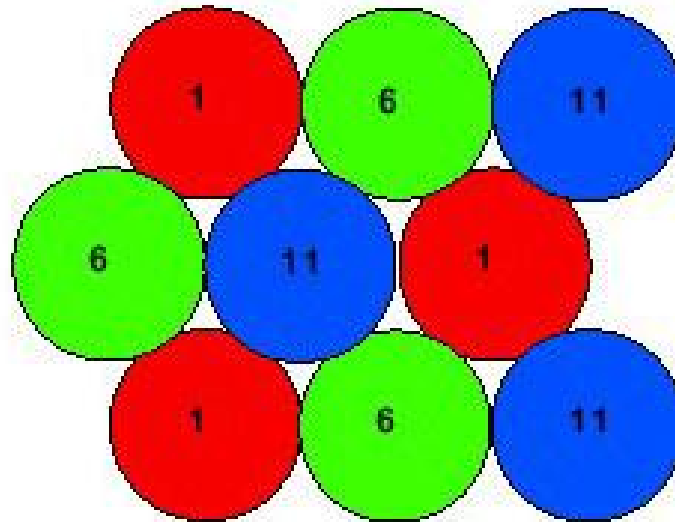
26 dBm @ MCS0/MCS8	802.11b best ≤ -90 dBm
26 dBm @ MCS1/MCS9	802.11g best ≤ -88 dBm
25 dBm @ MCS2/MCS10	802.11n best ≤ -85 dBm
25 dBm @ MCS3/MCS11	
24 dBm @ MCS4/MCS12	
24 dBm @ MCS5/MCS13	
23 dBm @ MCS6/MCS14	
23 dBm @ MCS7/MCS15	

Multiple APs

In a multiple AP environment, RF interference can be a factor.

FCC allows for only 3 non-overlapping channels between channels 1-11 (2.412 – 2.462).

Channels are 22MHz wide but only separated by 5MHz



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EAP150

- 802.11 ^{2.4GHz} **bg n**
- 150Mbps
- High Power : 26dBm
- 10/100 Ethernet
- Integrated 5dBi Antenna
- Wall Mount/ Ceiling Mount
- LED on/off Control
- Multiple SSID with VLAN
- SNMP Monitoring



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EAP300

- 802.11 ^{2.4GHz} **bg n**
- 300Mbps
- High Power : 29dBm
- 10/100 Ethernet
- Integrated 5dBi Antenna
- Wall Mount/ Ceiling Mount
- LED on/off Control
- Multiple SSID with VLAN
- SNMP Monitoring



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EAP350

- 802.11 ^{2.4GHz} **bgn**
- 300Mbps
- High Power : 29dBm
- Gigabit Ethernet
- Integrated 5dBi Antenna
- Wall Mount/ Ceiling Mount
- LED on/off Control
- Multiple SSID with VLAN
- SNMP Monitoring



Multiple SSIDs with VLANs

Lowers equipment and installation cost.

Separate networks for staff and guests using the same APs.

Must use switches that support VLAN tagging.

VLAN support only available in AP mode

The screenshot shows the configuration page for an EnGenius 2.4GHz Wireless-N Multi-function AP in Access Point Mode. The page includes a navigation menu on the left with options like System, Wireless, Status, Basic, Advanced, Security, Filter, WPS, Client List, VLAN, Network, Management, Tools, and Logout. The main configuration area includes fields for Radio (Enable/Disable), Mode (AP), Band (2.4 GHz (B+G+N)), Enabled SSID# (4), and four SSID entries (ESSID1-4) with values EnGenius1 through EnGenius4. There are also fields for Auto Channel (Enable/Disable) and Channel (6). The page also features a diagram on the right showing four cloud icons representing different networks: Engenius1 Guest Internet Access, Engenius2 Staff Network, Engenius3 IT Dept, and Engenius4 Security, along with an image of the physical AP device.

EnGenius® | 2.4GHz Wireless-N Multi-function AP

Access Point Mode

This page allows you to define Mode, Band, Multiple ESSID. You can also set up a static wireless channel or make Wireless device move to a clean Wireless Channel automatically.

Radio : Enable Disable

Mode : AP

Band : 2.4 GHz (B+G+N)

Enabled SSID# : 4

ESSID1 : EnGenius1

ESSID2 : EnGenius2

ESSID3 : EnGenius3

ESSID4 : EnGenius4

Auto Channel: Enable Disable

Channel : 6

Apply Cancel

Engenius1
Guest Internet Access

Engenius2
Staff Network

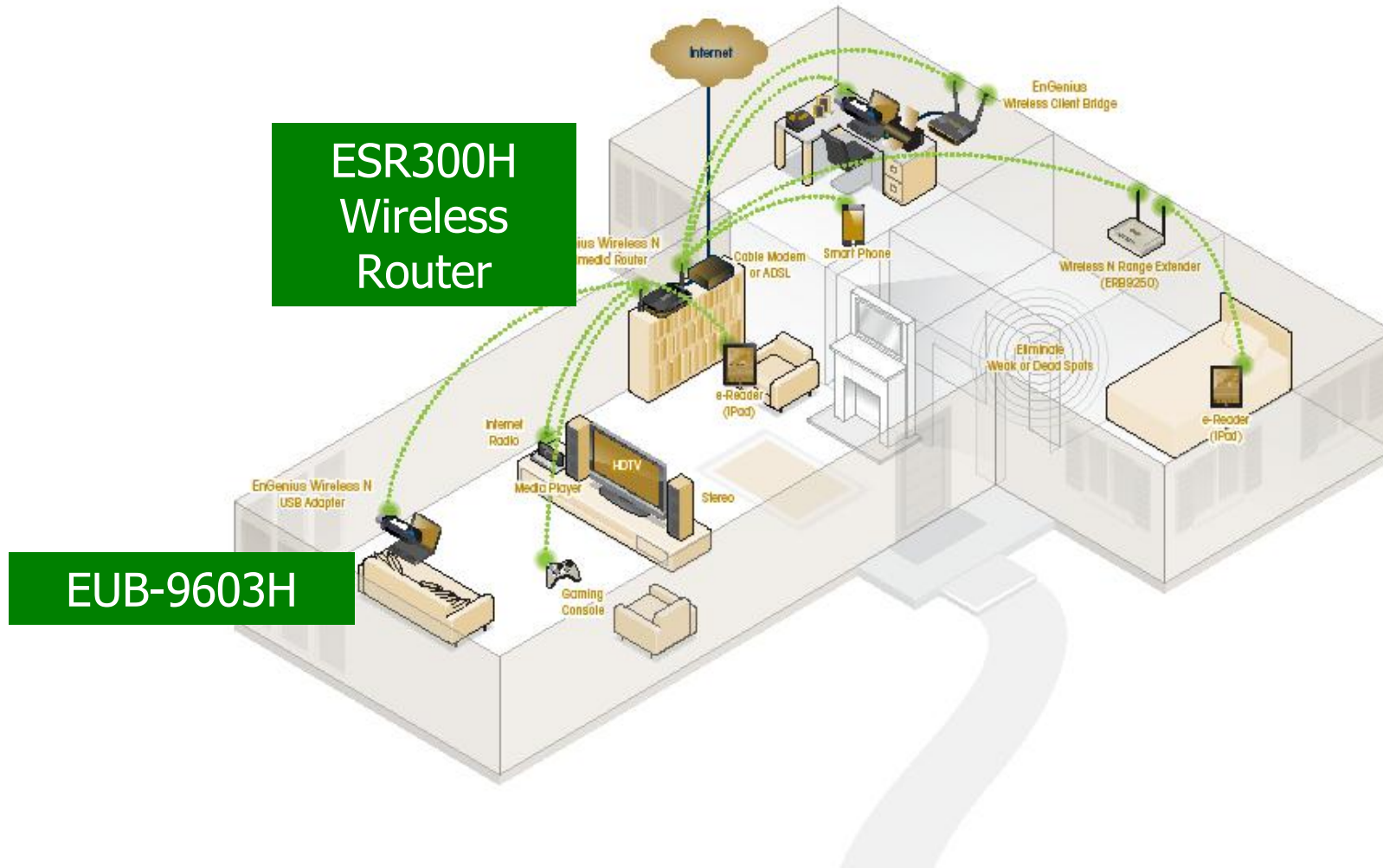
Engenius3
IT Dept

Engenius4
Security

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Wireless Home Network



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Wireless Router ESR300H

- 802.11 ^{2.4GHz} **bgn**
- 300Mbps
- High Power : 23dBm
- 4 x 10/100 Ethernet LAN ports
- 2 dBi Antennas
- Multiple SSID
- WPA / WPA2
- Advanced SPI Firewall
- VPN Server



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Wireless Dual Band Router ESR600H

5GHz (•••••) 2.4GHz

a b g n

- 802.11
- 300Mbps 2.4GHz and 5GHz
- High Power : 20dBm
- 4 x 10/100 /1000 Ethernet LAN ports
- 5 dBi external Antennas
- Multiple SSID
- USB port to share printer and hard drive wirelessly



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Wireless Dual Band Router ESR750H

5GHz (•••••) 2.4GHz

a b g n

- 802.11
- 300Mbps 2.4GHz
- 450Mbps 5GHz
- High Power : 20dBm
- 4 x 10/100/1000 Ethernet LAN ports
- 5 dBi Antennas
- Multiple SSID
- USB port to share printer, hard drive, and Apple devices wirelessly



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Long Range Wi-Fi Comparison



EnGenius Access Point

EnGenius High-power Wireless Access Point

Up to 4X Range



EnGenius Client

EnGenius High-power Wireless USB Adapter



EnGenius Access Point

EnGenius High-power Wireless Access Point

Brand X Client

Average Powered Wireless Device



2X Range



Brand X Access Point

Average Powered Wireless Device

EnGenius Client

EnGenius High-power Wireless USB Adapter



400ft



Brand X Access Point and Brand X Client

Average Powered Wireless Device

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USB 2.0 Client EUB9603H

- 802.11 ^{2.4GHz} **bgn**
- 150Mbps
- USB 2.0
- 600mW Tx
- 5dBi removable antenna
- Windows XP/Vista/7 and Intel Mac OS 10.4-10.7 driver support

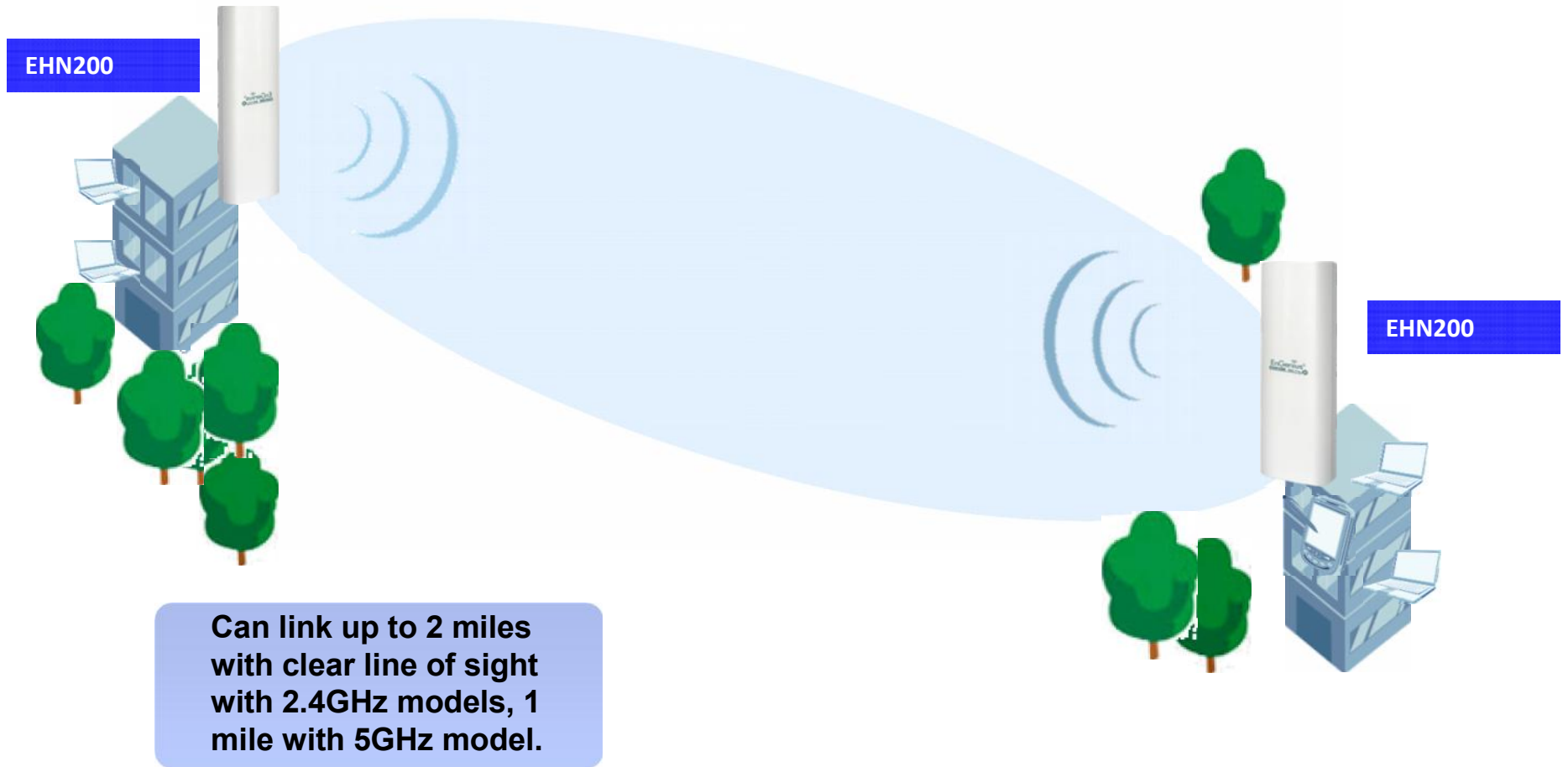


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ENH200, ENH202, ENH500

Point-to-Point Wireless Connection



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2.4GHz ENH200

- 150Mbps N Technology
- 802.11b/g backwards compatible
- 10/100 Ethernet main and auxiliary port.
- High Power 27dBm
- Integrated 10dBi Antenna with dual polarization
- IP55 Water proof design
- 24V PoE support



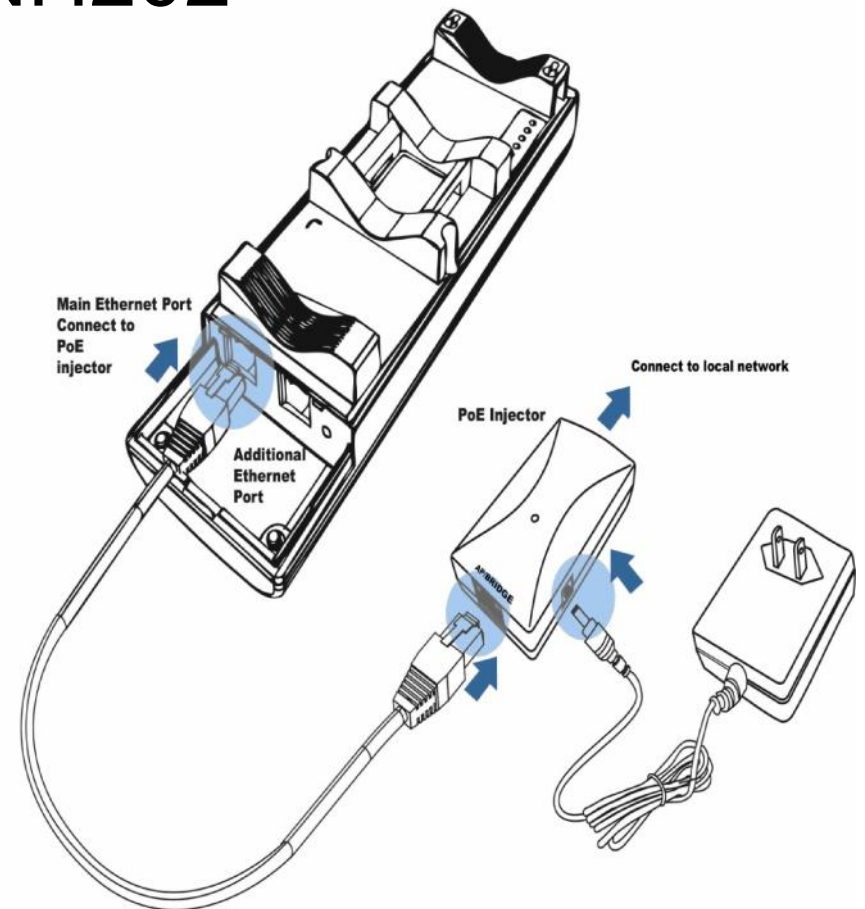
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2.4GHz ENH202

- 300Mbps N Technology
- 802.11b/g backwards compatible
- 10/100 Ethernet main and auxiliary port.
- High Power 27dBm
- Integrated 10dBi antenna with dual polarization
- IP55 Water proof design
- 24V PoE support



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5GHz ENH500

- 300Mbps N Technology
- 802.11a backwards compatible
- 10/100 Ethernet main and auxiliary port.
- High Power 27dBm
- Integrated 10dBi Antenna with dual polarization
- IP55 Water proof design
- 24V PoE support



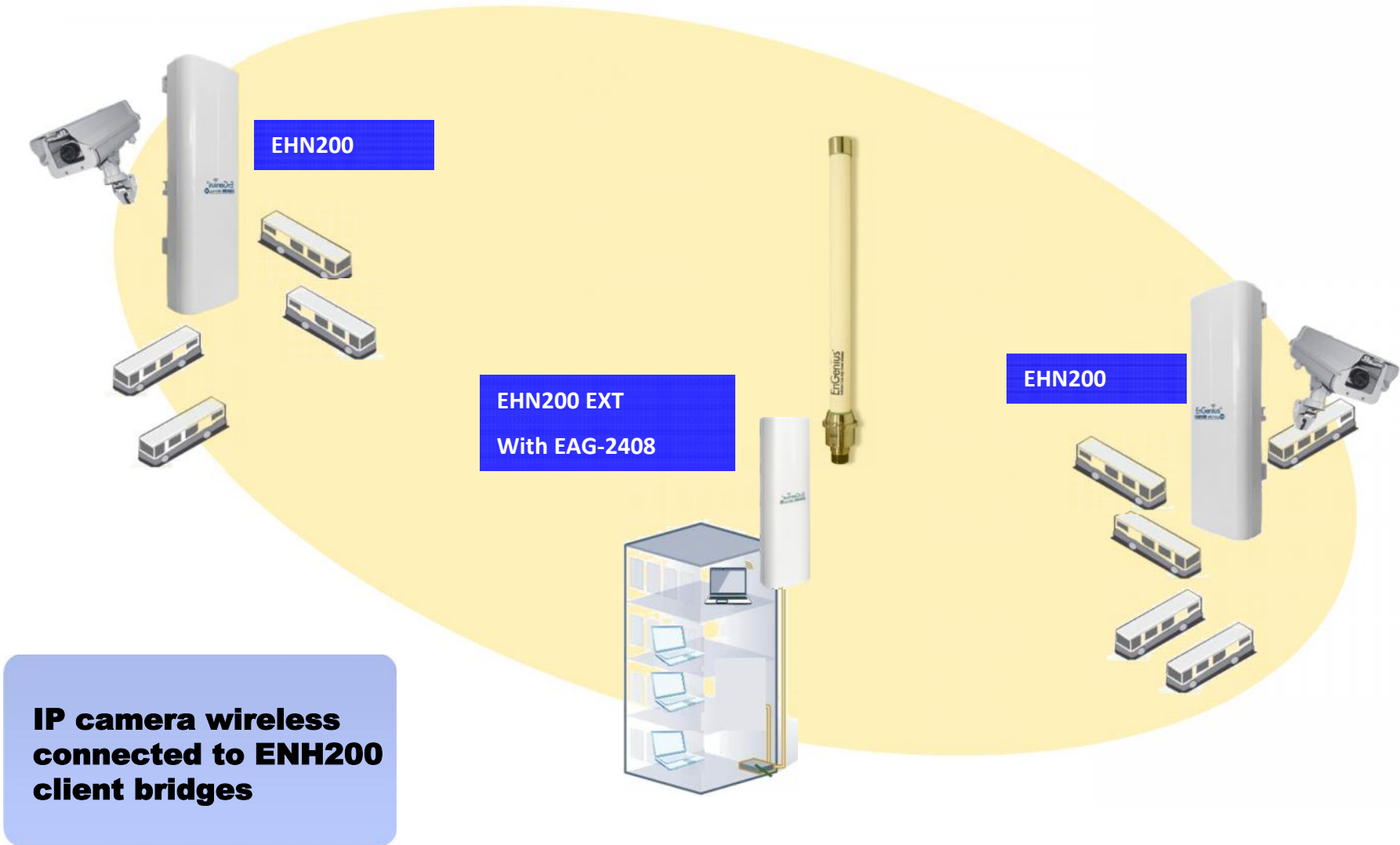
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ENH200 EXT

Outdoor Access Point



IP camera wireless connected to EHN200 client bridges

2.4GHz ENH200 EXT

- 150Mbps N Technology
- 802.11b/g backwards compatible
- High Power 27dBm
- IP55 Water proof design
- 24V PoE support
- RP-SMA antenna connector



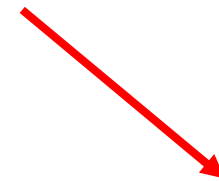
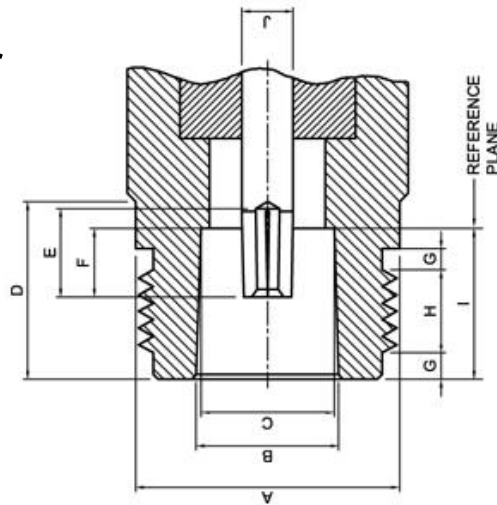
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Recommended Accessory EAG-2408

- 2.4 GHz antenna
- Omni-directional
- 8 dBi gain
- Type N female connector



Questions

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