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802 ac Standard, Overview and Features

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IEEE

- Institute of Electrical and Electronics Engineers
- Professional association formed in 1963
- Educational and technical advancement of electrical and electronic engineering, telecommunication and computer engineering

Responsible to standardize technologies

- ❑ Power and Energy
- ❑ Biomedical and healthcare
- ❑ Information technology and telecommunication

IEEE 802

- Refers to a family of standards dealing with LAN & MAN
- 802 is the date of first IEEE meeting (February 1980)
- 802 standards map to the lower 2 layers (physical and Data link layers)
- The most widely used standards are for the Ethernet family, Wireless LAN, Bridging and Virtual Bridged LANs

IEEE 802.11

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- Standards and specifications for implementing wireless local area network (WLAN) computer communication in the 2.4, 3.6, 5 and 60 GHz frequency bands

- The base version of the standard was released in 1997 consists of a series of half-duplex over the air modulation techniques

- 802.11b was the first widely accepted one followed by 802.11a, 802.11g, 802.11n, and 802.11ac

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802.11ac - Introduction

What is 802.11ac ?

- IEEE 802.11ac is the latest wireless networking standard in the 802.11 family.
- Provides high-throughput WLANs on the 5 GHz band
- Approved in January 2014.
- MikroTik introduced products for ac standard in July 2014.

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802.11ac - Specification

RF Bandwidth (Channel Width)

802.11ac can support up to 160 MHz Channel

Wider Channel Width= More Bandwidth

Wider Channel Width=Less Power (Distance)

Channel Width	RX Sensitivity	Data Rate
20MHz	Reference	Reference
40MHz	-3dB	X2
80MHz	-6dB	X4
10MHz	+3dB	1/2
5MHz	+6dB	1/4

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How Fast is 802.11ac ??

- The theoretical maximum speed of 802.11ac is **6.933Mbps** or just shy of **7Gbps.**

- It combines Eight **160MHz 256-QAM** channels.

- Each channel capable of **866.7Mbps.**

Overview of 802.11a/b/g/n and ac

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802.11 protocol	Release Date	Frequency (Ghz)	Bandwidth (Mhz)	Max data rate (Mbps)	Allowable MIMO Streams	Approximate range	
						Indoor Meters(m)	Outdoor Meters(m)
802.11-1997	June 1997	2.4	22	2	NA		100
							120
a	September 1999	5	20	54	NA		5000
b	September 1999	2.4	22	11	NA		140
g	June 2003	2.4	20	54	NA		140
			20	72.2		70	250
n	October 2009	2.4/5	40	150	4	70	250
			20	96.3		35	Not Known
			40	200		35	Not Known
			80	433		35	Not Known
ac	Jan-14	5	160	866.7	8	35	Not Known

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Difference Between 802.11ac and n

802.11 protocol	Frequency (Ghz)	Bandwidth (Mhz)	Max data rate (Mbps)	Allowable MIMO Streams	Approximate range	
					Indoor	Outdoor
					Meter (m)	Meter (m)
		20	96.3		35	
		40	200		35	
		80	433		35	
ac	5	160	866.7	8	35	
		20	72.2		70	250
n	2.4/5	40	150	4	70	250

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802.11ac Technologies

- "Space Division Multiple Access" (SDMA) - streams not separated by frequency, but instead resolved spatially.
- Downlink MU-MIMO - one transmitting device, multiple receiving devices; included as an optional mode
- Modulation - 256-QAM rate 3/4 and 5/6, added as optional modes (vs. 64-QAM, rate 5/6 maximum in 802.11n)
- Backward Compatible - Coexistence mechanisms for 20/40/80/160 MHz channels, 11ac and 11a/n devices

802.11ac Features

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- Extended channel binding
  - 80 MHz channel bandwidth for stations (vs. 40 MHz maximum in 802.11n), 160 MHz available optionally
- More MIMO spatial streams
  - Support for up to eight spatial streams (vs. four in 802.11n)
- Downlink Multi-user MIMO
  - (MU-MIMO, allows up to four simultaneous downlink MU-MIMO clients)
- Multiple STAs,
  - each with one or more antennas, transmit or receive independent data streams simultaneously

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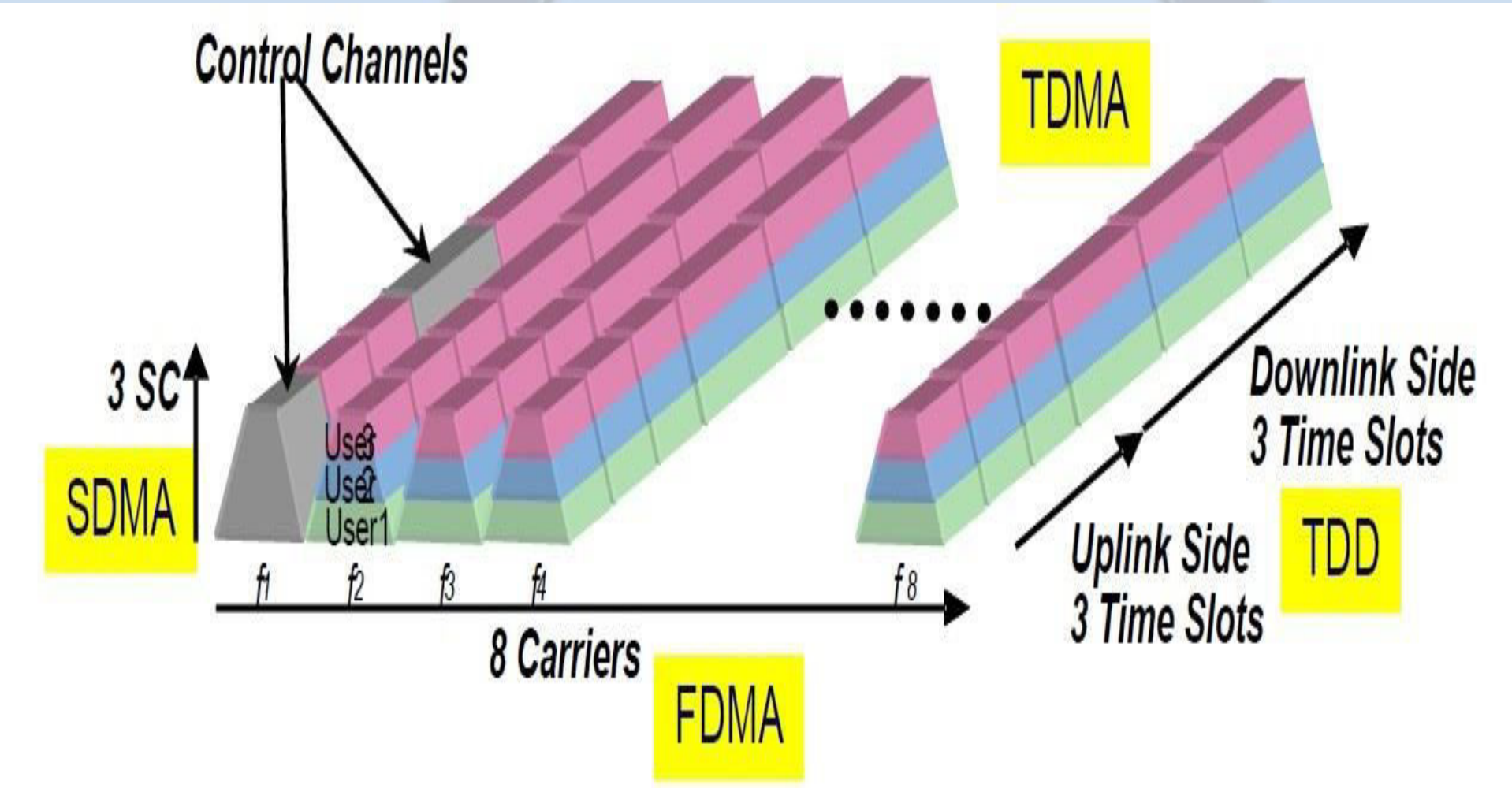
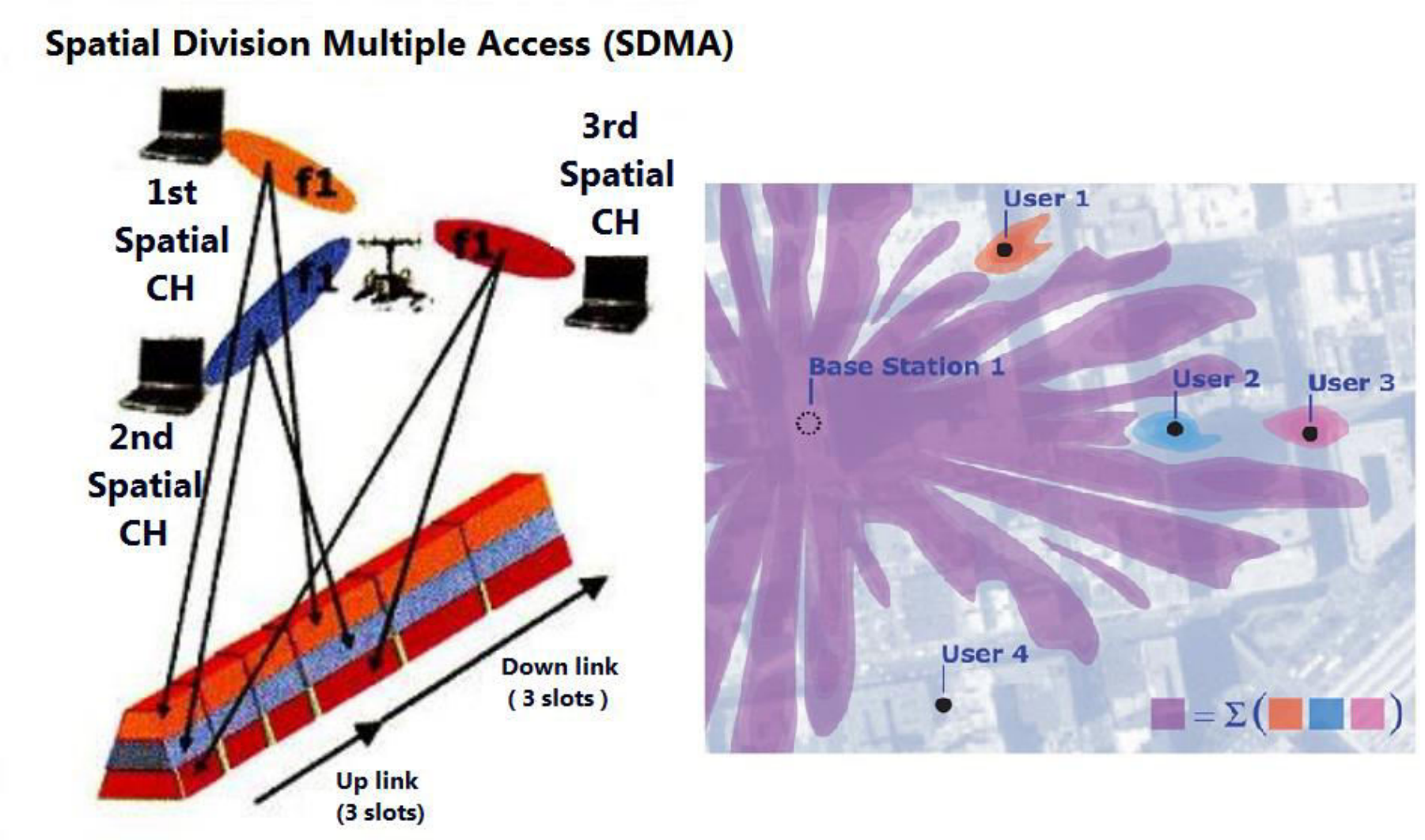
802.11ac uses SDMA

- Space-Division Multiple Access (SDMA)
- Creates parallel spatial pipes next to higher capacity pipes through spatial multiplexing.
- Superior performance in radio multiple access communication systems.
- Analogous to 11n-style MIMO

S D M A


Control Channels
TDMA
3 SC
SDMA
User3
User2
User1
f1
f2
f3
f4
f 8
8 Carriers
FDMA
Downlink Side
3 Time Slots
Uplink Side
3 Time Slots
TDD

S D M A


Spatial Division Multiple Access (SDMA)
1st Spatial CH
2nd Spatial CH
3rd Spatial CH
f1
f1
f1
Down link (3 slots)
Up link (3 slots)
User 1
Base Station 1
User 2
User 3
User 4

Data Rates (Single Spatial Stream)

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Theoretical throughput for single Spatial Stream (in Mbit/s)[a]										
MCS index[b]	Modulation type	Coding rate	20 MHz channels		40 MHz channels		80 MHz channels		160 MHz channels	
			800 ns GI[c]	400 ns GI	800 ns GI	400 ns GI	800 ns GI	400 ns GI	800 ns GI	400 ns GI
0	BPSK	1/2	6.5	7.2	13.5	15	29.3	32.5	58.5	65
1	QPSK	1/2	13	14.4	27	30	58.5	65	117	130
2	QPSK	3/4	19.5	21.7	40.5	45	87.8	97.5	175.5	195
3	16-QAM	1/2	26	28.9	54	60	117	130	234	260
4	16-QAM	3/4	39	43.3	81	90	175.5	195	351	390
5	64-QAM	2/3	52	57.8	108	120	234	260	468	520
6	64-QAM	3/4	58.5	65	121.5	135	263.3	292.5	526.5	585
7	64-QAM	5/6	65	72.2	135	150	292.5	325	585	650
8	256-QAM	3/4	78	86.7	162	180	351	390	702	780
9	256-QAM	5/6	N/A	N/A	180	200	390	433.3	780	866.7

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Data Rates (Two Spatial Streams)

Theoretical throughput for two Spatial Stream (in Mb/s)										
MCS index	Modulation type	Coding rate	20 MHz channels		40 MHz channels		80 MHz channels		160 MHz channels	
			800 ns GI	400 ns GI	800 ns GI	400 ns GI	800 ns GI	400 ns GI	800 ns GI	400 ns GI
6	64-QAM	3/4	117	130	243	270	**526.6**	585	**1053**	1170
7	64-QAM	5/6	130	144.4	270	300	**585**	650	**1170**	1300
8	256-QAM	3/4	156	173.4	324	360	**702**	780	**1040**	1560
9	256-QAM	5/6	N/A	N/A	360	400	**780**	866.6	**1560**	1733,4

802.11ac Configuration

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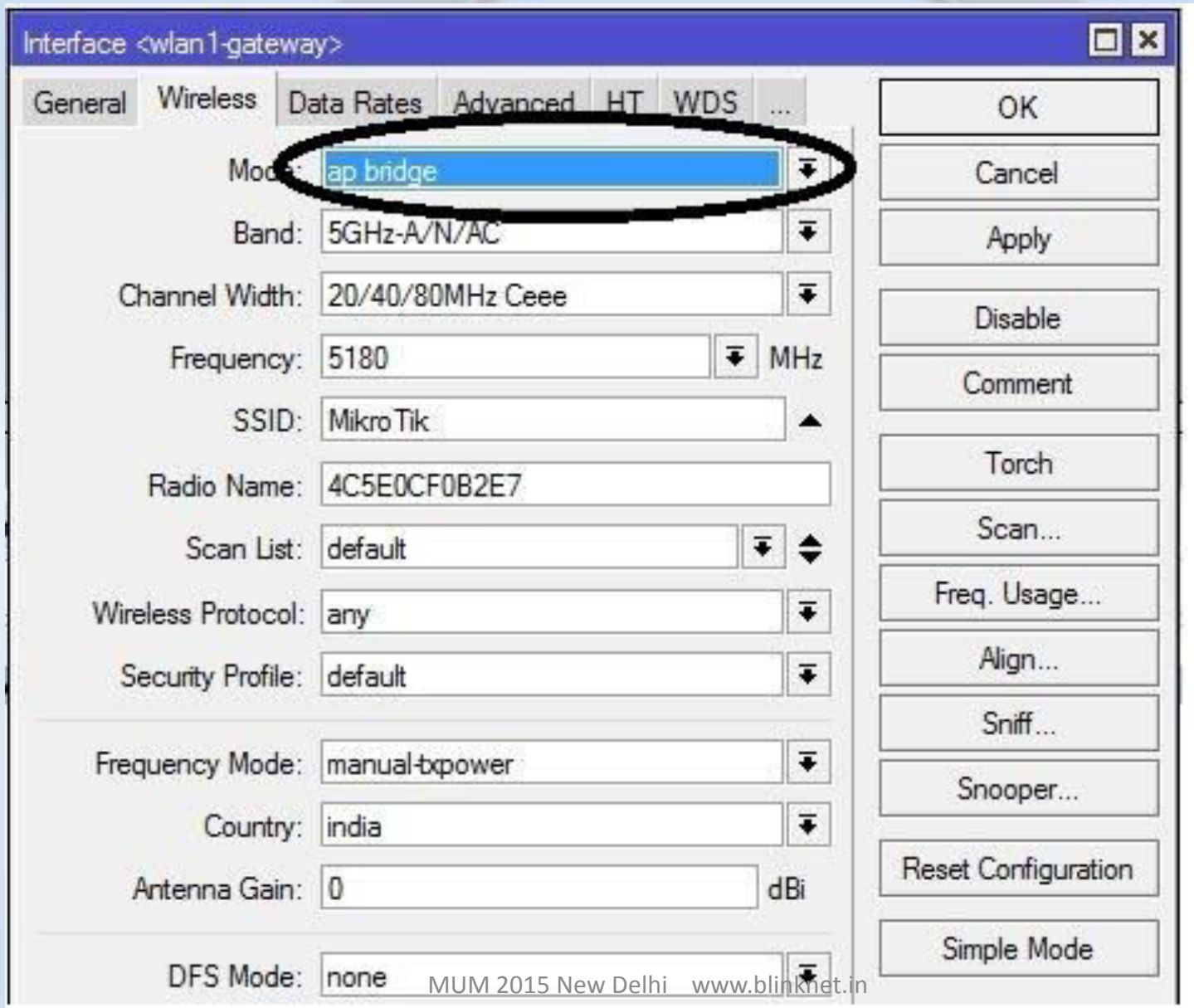

802.11ac Configuration

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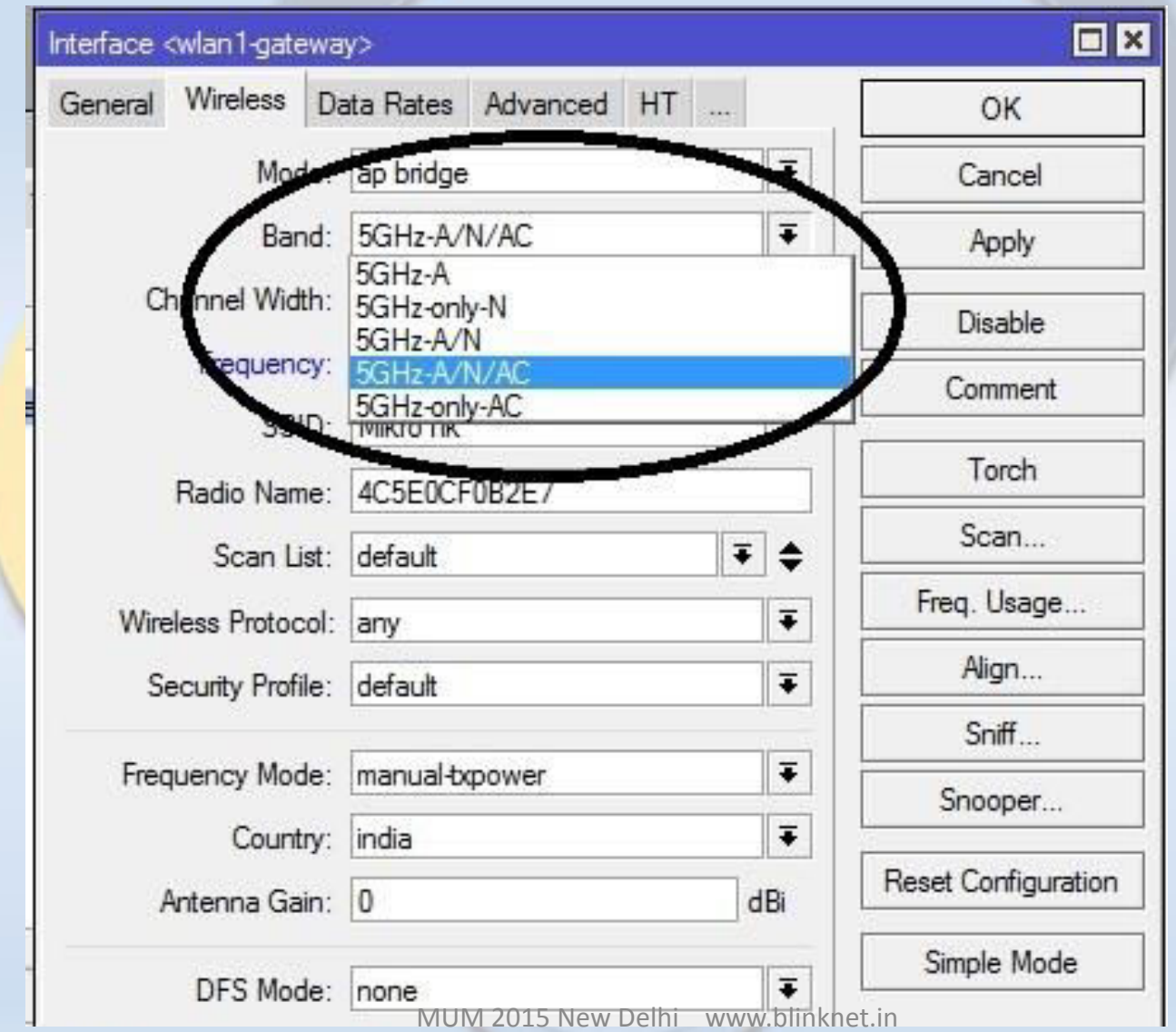

802.11ac Configuration

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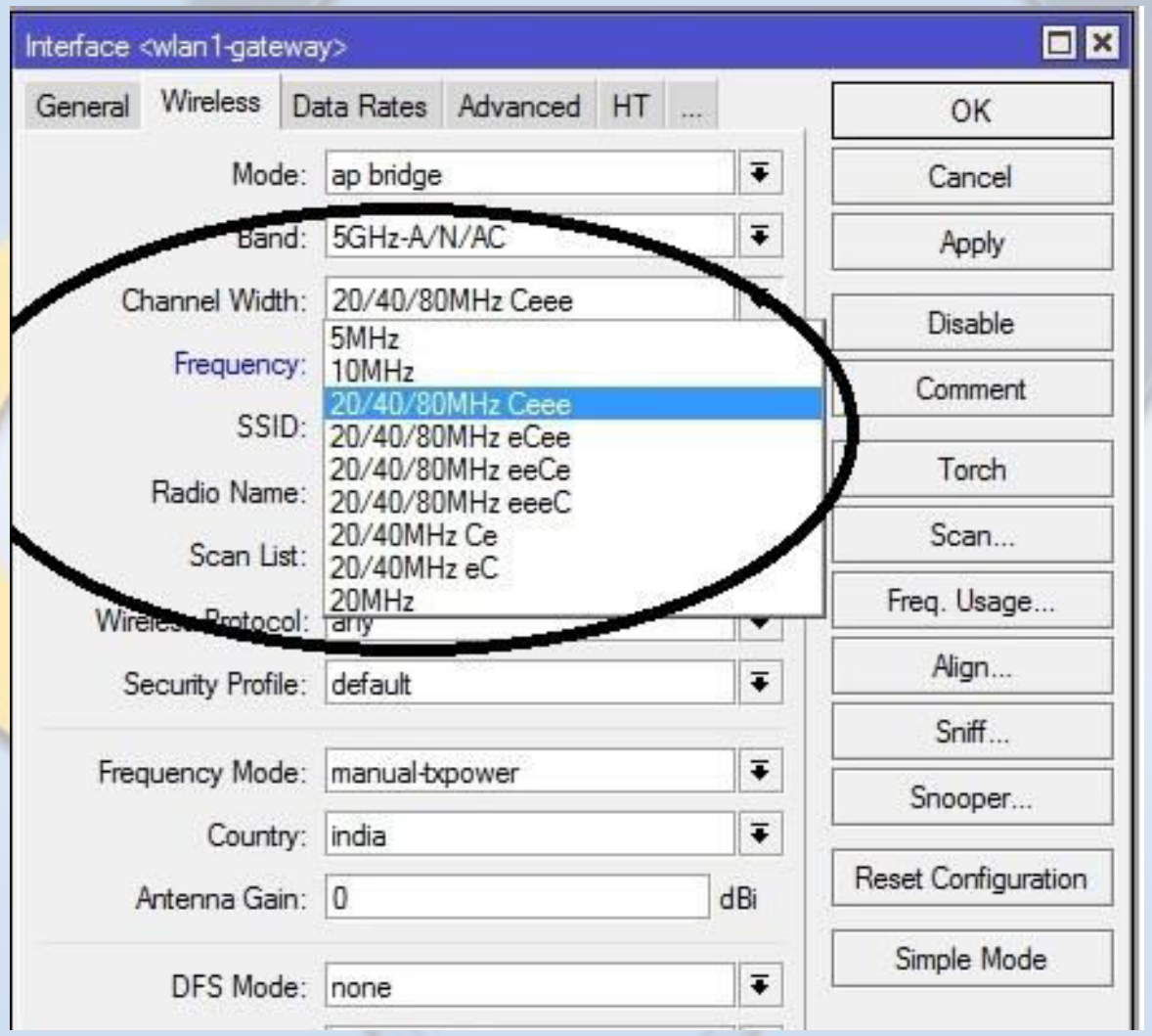

802.11ac Configuration

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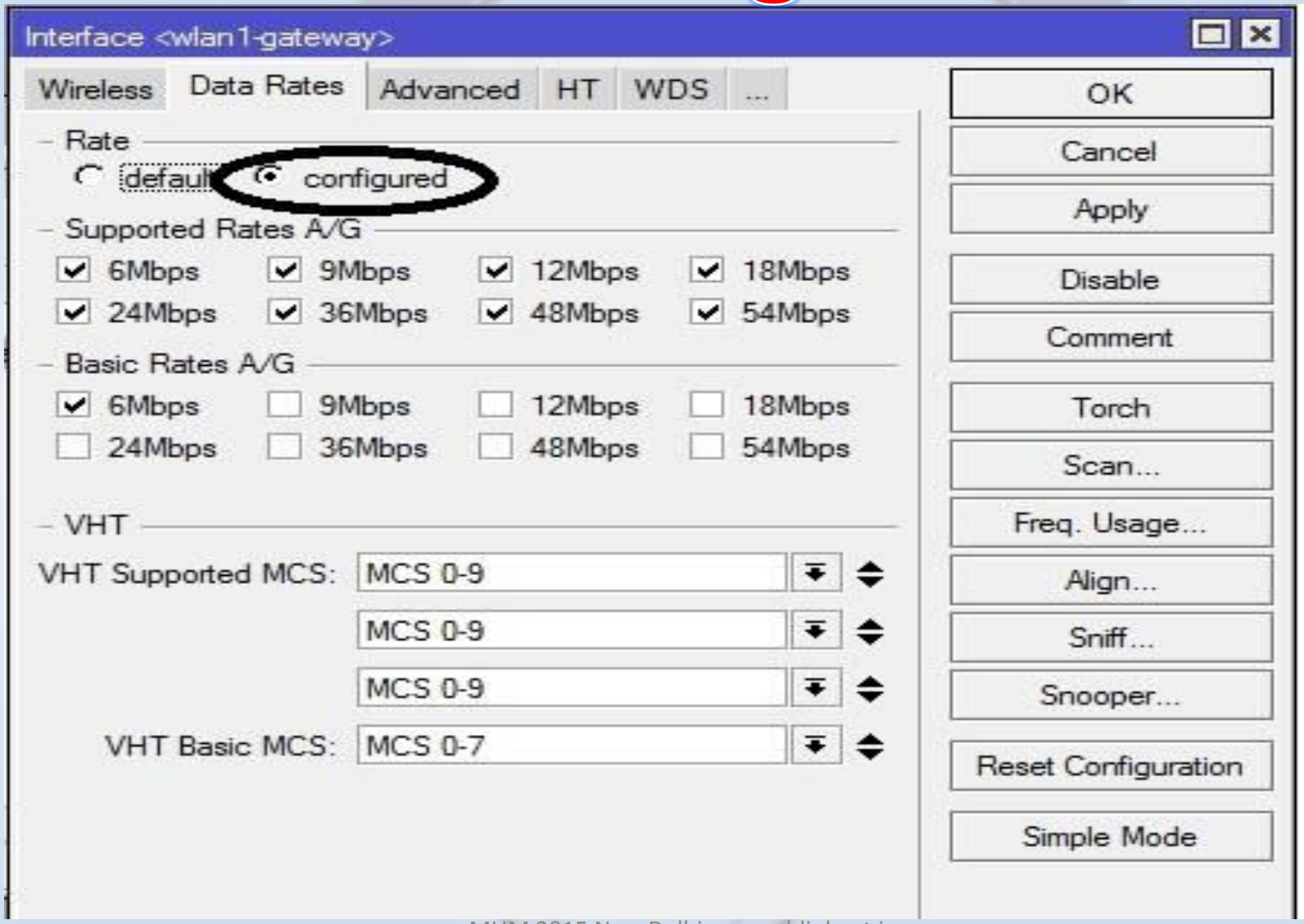

802.11ac Products from Mikrotik

Wireless systems

QRT 5 ac
Dual chain 5GHz 802.11a/n/ac QCA9882, 128 MB RAM, 720 MHz CPU, 24 DBi antenna gain

DynaDish 5
Dual chain 5GHz 802.11a/n/ac QCA9882, 128MB RAM, 720 MHz CPU, 25dBi antenna gain

NetMetal 5
Triple chain 5GHz integrated 802.11ac AP/Backbone/CPE with an additional miniPCI-e slot, Gigabit Ethernet, waterproof metal enclosure

NetMetal 5
Dual chain 5GHz integrated 802.11ac AP/Backbone/CPE with an additional miniPCI-e slot, 2xRPSMA connectors, Gigabit Ethernet, waterproof metal enclosure

NetMetal 5
Triple chain 5GHz integrated 802.11ac AP/Backbone/CPE, 3xRPSMA connectors, 2000mW TX power, Gigabit Ethernet, waterproof metal enclosure

802.11ac Products from Mikrotik

NetMetal 5
Dual chain 5GHz integrated 802.11ac AP/Backbone/CPE, 2xRPSMA connectors, 2000mW TX power, Gigabit Ethernet, waterproof metal enclosure

SXT 5 ac
802.11ac up to 540Mbit, 1300mW RF output, low latency Point to Point

SXT SA5 ac
802.11ac up to 540Mbit, 1300mW RF output, wide beamwidth sector antenna

SXT HG5 ac
Dual chain 5GHz 802.11a/n/ac QCA9882, 128 MB RAM, 720 MHz CPU, 17 DBI antenna gain

NetBox 5
802.11ac support for up to 540Mbits, waterproof enclosure, 1300mW output

Thanking You

MikroTik

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