

WLAN Theoretical Throughput Calculator for 802.11a/b/g/n/ac standards

Goal: Use a python script to take various user inputs such as frame sizes, MIMO types, 802.11a/b/g/ac modes etc and calculate the maximum theoretical MAC and IP layer throughput.

Calculating WLAN theoretical throughput is any important step in being able to benchmark the throughput of Access Points. This calculator will allow users to compare achieved performance to theoretical maximum performance and see how well their APs perform. In this cookbook we show how user can run a simple python script and calculate theoretical throughput for various combinations. Using the script from [wlan_capacity_calculator.py](#).

1.

Script Input Options

A. **python wlan_capacity_calculator.py -h**

Output display in terminal:

```

C:\ALL_projects\GUI Calculator\Final_files>python Frame_ratesv7_commnad_line.py -h
usage: Frame_ratesv7_commnad_line.py [-h] [-sta STATION] [-t TRAFFIC] [-p PHY] [-e ENCRYPTION] [-q QOS] [-m MAC] [-b BASIC [BASIC ...]] [-pre PREAMBLE] [-s SLOT]
[-co CODEC] [-r RTS] [-c CTS] [-d DATA] [-ch CHANNEL] [-gu GUARD] [-high HIGHEST] [-pl PLCP] [-ip IP] [-mc MC] [-cw CWIN]
[-spa SPATIAL] [-rc RTSCTS]

WLAN Capacity Calculator
optional arguments:
  -h, --help            show this help message and exit
  -sta STATION, --station STATION
                        Enter Station Name : [11abg,11n,11ac](by Default 11abg)
  -t TRAFFIC, --traffic TRAFFIC
                        Enter the Traffic Type : [Data,Voice](by Default Data)
  -p PHY, --phy PHY     Enter the PHY Bit Rate of Data Flow : [1, 2, 5.5, 11, 6, 9, 12, 18, 24, 36, 48, 54](by Default 54)
  -e ENCRYPTION, --encryption ENCRYPTION
                        Enter the Encryption : [None, WEP, TKIP, CCMP](by Default None)
  -q QOS, --qos QOS     Enter the QoS = : [No, Yes](by Default [No for 11abg] and [Yes for 11n])
  -m MAC, --mac MAC     Enter the 802.11 MAC Frame : [Any Value](by Default [106 for 11abg] and [1538 for 11n])
  -b BASIC [BASIC ...], --basic BASIC [BASIC ...]
                        Enter the Basic Rate Set : [1,2, 5.5, 11, 6, 9, 12, 18, 24, 36, 48, 54] (by Default [1 2 5.5 11 6 12] for 11abg, [6 12 24] for 11n/11ac)
  -pre PREAMBLE, --preamble PREAMBLE
                        Enter Preamble value : [ Short, Long, N/A](by Default Short)
  -s SLOT, --slot SLOT Enter the Slot Time : [Short, Long, N/A](by Default Short)
  -co CODEC, --codec CODEC
                        Enter the Codec Type (Voice Traffic): {[ 6.711 , 6.723 , 6.729]}by Default 6.723 for 11abg, 6.711 for 11n) and{['Mixed','Greenfield'] by Default
Mixed for 11ac)
  -r RTS, --rts RTS     Enter the RTS/CTS Handshake : [No, Yes](by Default No)
  -c CTS, --cts CTS     Enter the CTS-to-self (protection) : [No, Yes](by Default No)
  -d DATA, --data DATA
                        Enter the Data/Voice MCS Index : ['0','1','2','3','4','5','6','7','8','9','10','11','12','13','14','15','16','17','18','19','20','21','22','23','
24','25','26','27','28','29','30','31']by Default 7
  -ch CHANNEL, --channel CHANNEL
                        Enter the Channel Bandwidth = : ['20','40'] by Default 40 for 11n and ['20','40','80'] by Default 80 for 11ac
  -gu GUARD, --guard GUARD
                        Enter the Guard Interval = : ['400','800'] (by Default 400)
  -high HIGHEST, --highest HIGHEST
                        Enter the Basic Rate Set : [1,2, 5.5, 11, 6, 9, 12, 18, 24, 36, 48, 54] (by Default [1 2 5.5 11 6 12] for 11abg, [6 12 24] for 11n/11ac)
  -pre PREAMBLE, --preamble PREAMBLE
                        Enter Preamble value : [ Short, Long, N/A](by Default Short)
  -s SLOT, --slot SLOT Enter the Slot Time : [Short, Long, N/A](by Default Short)
  -co CODEC, --codec CODEC
                        Enter the Codec Type (Voice Traffic): {[ 6.711 , 6.723 , 6.729]}by Default 6.723 for 11abg, 6.711 for 11n) and{['Mixed','Greenfield'] by Default
Mixed for 11ac)
  -r RTS, --rts RTS     Enter the RTS/CTS Handshake : [No, Yes](by Default No)
  -c CTS, --cts CTS     Enter the CTS-to-self (protection) : [No, Yes](by Default No)
  -d DATA, --data DATA
                        Enter the Data/Voice MCS Index : ['0','1','2','3','4','5','6','7','8','9','10','11','12','13','14','15','16','17','18','19','20','21','22','23','
24','25','26','27','28','29','30','31']by Default 7
  -ch CHANNEL, --channel CHANNEL
                        Enter the Channel Bandwidth = : ['20','40'] by Default 40 for 11n and ['20','40','80'] by Default 80 for 11ac
  -gu GUARD, --guard GUARD
                        Enter the Guard Interval = : ['400','800'] (by Default 400)
  -high HIGHEST, --highest HIGHEST
                        Enter the Highest Basic MCS = : ['0','1','2','3','4','5','6','7','8','9','10','11','12','13','14','15','16','17','18','19','20','21','22','23','2
4','25','26','27','28','29','30','31'](by Default 1)
  -pl PLCP, --plcp PLCP
                        Enter the PLCP Configuration = : ['Mixed','Greenfield'] (by Default Mixed) for 11n
  -ip IP, --ip IP       Enter the IP Packets per A-MSDU = : ['0','1','2','3','4','5','6','7','8','9','10','11','12','13','14','15','16','17','18','19','20'] (by Default
0)
  -mc MC, --mc MC      Enter the MAC Frames per A-MPDU = : ['0','1','2','3','4','5','6','7','8','9','10','11','12','13','14','15','16','17','18','19','20','21','22','23
','24','25','26','27','28','29','30','31','32','33','34','35','36','37','38','39','40','41','42','43','44','45','46','47','48','49','50','51','52
','53','54','55','56','57','58','59','60','61','62','63','64'](by Default [42 for 11n] and [64 for 11ac])
  -cw CWIN, --cwin CWIN
                        Enter the CWin (Leave alone for default) = : [Any Value] (by Default 15)
  -spa SPATIAL, --spatial SPATIAL
                        Enter the Spatial Streams = [1,2,3,4] (by Default 4)
  -rc RTSCTS, --rtscts RTSCTS
                        Enter the RTS/CTS Handshake and CTS-to-self = ['No','Yes'] (by Default No for 11ac)

```

2.

Run Script for 11abg Calculator

Given below are some example of how we can calculate 802.11abg theoretical throughput

A. By Default:

```
> python wlan_capacity_calculator.py -sta 11abg
```

or

```
> python wlan_capacity_calculator.py
```

Output display in terminal (Client 1):

```
C:\All_projects\GUI Calculator\Final files>python Frame_ratesv7_commnad_line.py -sta 11abg

*****Station : 11abgCalculator*****

Theoretical Maximum Offered Load

1 Client:
{
  "Packet Interval(usec)": "393.50",
  "Max Frame Rate(fps)": 2541,
  "Max. Offered Load (802.11)(Mb/s)": "30.861",
  "Offered Load Per 802.11 Client(Mb/s)": "30.861",
  "Offered Load (802.3 Side)(Mb/s)": "30.496",
  "IP Throughput (802.11 -> 802.3)(Mb/s)": "30.130"
}

Theroretical Voice Call Capacity

{
  "Maximum Theoretical R-value": "N/A",
  "Estimated MOS Score": "N/A",
  "Maximum Bidirectional Voice Calls(calls)": "N/A"
}
```

B. With Input Parameters:

```
python wlan_capacity_calculator.py -sta 11abg -t Voice -p 48 -m 106 -e WEP  
-q Yes -b 1 2 5.5 11 -pre Long -s N/A -co G.711 -r Yes -c Yes
```

Output display in terminal (Client 1):

```
{  
C:\All_projects\modify wlan_calculator\lanforge-scripts-master\py-scripts>python wlan_capacity_calculator.py -sta  
11abg -t Voice -p 48 -m 106 -e WEP -q Yes -b 1 2 5.5 11 -pre Long -s N/A -co G.711 -r Yes -c Yes  
  
*****Station : 11abgCalculator*****  
  
Theoretical Maximum Offered Load  
  
1 Client:  
{  
  "Packet Interval(usec)": "890.91",  
  "Max Frame Rate(fps)": 1122,  
  "Max. Offered Load (802.11)(Mb/s)": "2.209",  
  "Offered Load Per 802.11 Client(Mb/s)": "2.209",  
  "Offered Load (802.3 Side)(Mb/s)": "0.700",  
  "IP Throughput (802.11 -> 802.3)(Mb/s)": "0.539"  
}  
  
Theoretical Voice Call Capacity  
  
{  
  "Maximum Theoretical R-value": 85.9,  
  "Estimated MOS Score": 4.23,  
  "Maximum Bidirectional Voice Calls(calls)": 16.77  
}  
  
C:\All_projects\modify wlan_calculator\lanforge-scripts-master\py-scripts>
```

3.

Run Script for 11n Calculator

Given below are some example of how we can calculate 802.11ac theoretical throughput

A. By Default:

```
> python wlan_capacity_calculator.py -sta 11n
```

Output display in terminal (Client 1):

```
C:\All_projects\GUI Calculator\Final files>python Frame_ratesv7_commnad_line.py -sta 11n
*****Station : 11nCalculator*****

Theoretical Maximum Offered Load

1 Client:
{
  "MAC PDU Interval(usec)": "3601.90",
  "Max PDU Rate(fps)": "277.63",
  "Max MAC MPDU Rate": 11661,
  "Max MAC MSDU Rate": 11661,
  "Max. 802.11 MAC Frame Data Rate(Mb/s)": "141.605",
  "Max. 802.11 MAC Payload Goodput(Mb/s)": "138.807",
  "MAC Goodput Per 802.11 Client(Mb/s)": "138.807",
  "Offered Load (802.3 Side)(Mb/s)": "139.740",
  "IP Goodput (802.11 -> 802.3)(Mb/s)": "138.060"
}

Theroretical Voice Call Capacity
{
  "Maximum Theoretical R-value": "N/A",
  "Estimated MOS Score": "N/A",
  "Maximum Bidirectional Voice Calls(calls)": "N/A"
}
```

B. With Input Parameters:

```
> python wlan_capacity_calculator.py -sta 11n -t Voice -d 17 -ch 40 -gu 800 -high 9
-e WEP -q Yes -ip 5 -mc 42 -b 6 9 12 24 -m 1538 -co G.729 -pl Greenfield
-cw 15 -r Yes -c Yes
```

Output display in terminal (Client 1):

```
C:\All_projects\modify wlan calculator\lanforge-scripts-master\py-scripts>python wlan_capacity_calculator.py -sta
11n -t Voice -d 17 -ch 40 -gu 800 -high 9 -e WEP -q Yes -ip 5 -mc 42 -b 6 9 12 24 -m 1538 -co G.729 -pl Greenfield
-cw 15 -r Yes -c Yes

*****Station : 11nCalculator*****

Theoretical Maximum Offered Load

1 Client:
{
  "MAC PDU Interval(usec)": "505.50",
  "Max PDU Rate(fps)": "1978.24",
  "Max MAC MPDU Rate": 83086,
  "Max MAC MSDU Rate": 415430,
  "Max. 802.11 MAC Frame Data Rate(Mb/s)": "25.258",
  "Max. 802.11 MAC Payload Goodput(Mb/s)": "-59.822",
  "MAC Goodput Per 802.11 Client(Mb/s)": "-59.822",
  "Offered Load (802.3 Side)(Mb/s)": "N/A",
  "IP Goodput (802.11 -> 802.3)(Mb/s)": "N/A"
}

Theroretical Voice Call Capacity
{
  "Maximum Theoretical R-value": 81.7,
  "Estimated MOS Score": "4.09",
  "Maximum Bidirectional Voice Calls(calls)": 4757.86
}
```

4.

Run Script for 11ac Calculator

Given below are some example of how we can calculate 802.nabg theoretical throughput

A. By Default:

```
> python wlan_capacity_calculator.py -sta 11ac
```

Output display in terminal (Client 1):

```
C:\All_projects\GUI Calculator\Final files>python Frame_ratesv7_commnad_line.py -sta 11ac

*****Station : 11ac Calculator*****

Theoretical Maximum Offered Load

1 Client:
{
  "MAC PDU Interval(usec)": "655.10",
  "Max PDU Rate(fps)": "1526.48",
  "Max MAC MPDU Rate": 97695,
  "Max MAC MSDU Rate": 97695,
  "Max. 802.11 MAC Frame Data Rate(Mb/s)": "1186.408",
  "Max. 802.11 MAC Payload Goodput(Mb/s)": "1162.961",
  "MAC Goodput Per 802.11 Client(Mb/s)": "1162.961",
  "Offered Load (802.3 Side)(Mb/s)": "1170.777",
  "IP Goodput (802.11 -> 802.3)(Mb/s)": "1156.709"
}

Theroretical Voice Call Capacity

{
  "Maximum Theoretical R-value": "N/A",
  "Estimated MOS Score": "N/A",
  "Maximum Bidirectional Voice Calls(calls)": "N/A"
}
```

B. With Input Parameters:

```
python wlan_capacity_calculator.py -sta 11ac -t Voice -d 9 -spa 3 -ch 20 -gu 800
-high 1 -e TKIP -q Yes -ip 3 -mc 0 -b 6 12 24 54 -m 1518 -co Greenfield -cw 15 -rc Yes
```

Output display in terminal (Client 1):

```
C:\All_projects\modify wlan calculator\lanforge-scripts-master\py-scripts>python wlan_capacity_calculator.py -sta
11ac -t Voice -d 9 -spa 3 -ch 20 -gu 800 -high 1 -e TKIP -q Yes -ip 3 -mc 0 -b 6 12 24 54 -m 1518 -co Greenfield -
cw 15 -rc Yes

*****Station : 11ac Calculator*****

Theoretical Maximum Offered Load

1 Client:
{
  "MAC PDU Interval(usec)": "241.50",
  "Max PDU Rate(fps)": "4140.79",
  "Max MAC MPDU Rate": 4141,
  "Max MAC MSDU Rate": 12422,
  "Max. 802.11 MAC Frame Data Rate(Mb/s)": "3.412",
  "Max. 802.11 MAC Payload Goodput(Mb/s)": "0.000",
  "MAC Goodput Per 802.11 Client(Mb/s)": "0.000",
  "Offered Load (802.3 Side)(Mb/s)": "N/A",
  "IP Goodput (802.11 -> 802.3)(Mb/s)": "N/A"
}

Theroretical Voice Call Capacity

{
  "Maximum Theoretical R-value": 85.9,
  "Estimated MOS Score": "4.23",
  "Maximum Bidirectional Voice Calls(calls)": 171.09
}
```

