Who is the best network provider in Dec 2021

(parameters : speed more than average speed, strong signal strength, more 4G technology)

Import required Libraries

In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

Load Dataset

In [3]:
```
myspeed= pd.read_csv('December_MySpeed_2021.csv')
```

Explore Dataset

In [4]:
```
myspeed.head(10)
```

Out[4]:

	operator	technology	download	speed	signal_strength	lsa
0	AIRTEL	4G	download	33873.0	-94	NaN
1	AIRTEL	4G	upload	4545.0	na	NaN
2	AIRTEL	4G	upload	7053.0	-86	Haryana
3	AIRTEL	4G	upload	15713.0	-86	Haryana
4	AIRTEL	4G	upload	25746.0	-95	NaN
5	AIRTEL	4G	upload	6629.0	-87	NaN
6	AIRTEL	4G	upload	9603.0	-90	NaN
7	AIRTEL	4G	upload	97.0	-98	NaN
8	AIRTEL	4G	upload	8939.0	-92	NaN
9	AIRTEL	4G	upload	8918.0	-92	NaN

In [5]:
```
myspeed.tail(10)
```

Out[5]:

	operator	technology	download	speed	signal_strength	lsa
957966	AIRTEL	4G	download	12966.0	-96	NaN
957967	AIRTEL	4G	download	22995.0	-74	NaN
957968	AIRTEL	4G	download	12321.0	-97	NaN
957969	AIRTEL	4G	download	63499.0	-104	NaN
957970	AIRTEL	4G	download	2690.0	-106	NaN
957971	AIRTEL	4G	download	21126.0	-81	NaN
957972	AIRTEL	4G	download	22196.0	-95	NaN
957973	AIRTEL	4G	download	17356.0	-107	NaN
957974	AIRTEL	4G	download	593.0	-91	NaN
957975	AIRTEL	4G	download	2386.0	-94	NaN

In [6]:
```
myspeed.shape
```

Out[6]:
```
(957976, 6)
```

In [7]:
```
myspeed.columns
```

Out[7]:
```
Index(['operator', 'technology', 'download', 'speed', 'signal_strength',
       'lsa'],
      dtype='object')
```

In [8]:
```
myspeed.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 957976 entries, 0 to 957975
Data columns (total 6 columns):
 #   Column           Non-Null Count   Dtype  
---  ------           --------------   -----  
 0   operator         957976 non-null  object 
 1   technology       957976 non-null  object 
 2   download         957976 non-null  object 
 3   speed            957717 non-null  float64
 4   signal_strength  957976 non-null  object 
 5   lsa              229475 non-null  object 
dtypes: float64(1), object(5)
memory usage: 43.9+ MB
```

In [9]:
```
myspeed.isnull().sum()
```

Out[9]:
```
operator               0
technology             0
download               0
speed                259
signal_strength        0
lsa                728501
dtype: int64
```

In [10]:
```
for i in myspeed.describe( include= object):
    print(i)
    print(myspeed[i].unique())
    print('.'*25)
```

```
operator
['AIRTEL' 'Vi India' 'CELLONE' 'JIO']
.........................
technology
['4G' '3G']
.........................
download
['download' 'upload']
.........................
signal_strength
['-94' 'na' '-86' '-95' '-87' '-90' '-98' '-92' '-96' '-89' '-84' '-85'
 '-91' '-102' '-103' '-106' '-109' '-108' '-110' '-83' '-100' '-72' '-88'
 '-76' '-111' '-74' '-77' '-71' '-81' '-66' '-69' '-73' '-75' '-70' '-67'
 '-97' '-80' '-93' '-105' '-78' '-79' '-101' '-99' '-104' '-107' '-82'
 '-112' '-68' '-62' '-55' '-51' '-59' '-61' '-57' '-53' '-65' '-63' '-52'
 '-60' '-54' '-58' '-64' '-56' '-50']
.........................
lsa
[nan 'Haryana' 'Maharashtra' 'Rajasthan' 'Bihar' 'Delhi' 'Karnataka'
 'Andhra Pradesh' 'Kolkata' 'Kerala' 'Tamil Nadu' 'UP East' 'West Bengal'
 'UP West' 'Gujarat' 'Chennai' 'Mumbai' 'North East' 'Assam'
 'Madhya Pradesh' 'Orissa' 'Himachal Pradesh' 'Punjab' 'Jammu & Kashmir']
.........................
```

In [11]:
```
## value counts in signal strength column because of 'na' is in string ty

myspeed['signal_strength'].value_counts()
```

Out[11]:
```
signal_strength
na     64360
-90    46656
-97    31656
-95    29541
-96    29093
       ...
-53      276
-56      245
-54      207
-52      149
-50      140
Name: count, Length: 64, dtype: int64
```

Data Cleaning and Modification

In [12]:
```
''' Replace NaN value of lsa by Loc_na (location not available) because t
and will not be good idea to drop them all as this column not required fo

myspeed['lsa'].replace( to_replace= np.nan, value='Loc_na', inplace= True
```

In [13]:
```
## Replace 'na' with NaN in signal strength column

myspeed['signal_strength'].replace(to_replace='na', value= np.nan, inplac
```

In [14]:
```
myspeed.head(10)
```

Out[14]:

	operator	technology	download	speed	signal_strength	lsa
0	AIRTEL	4G	download	33873.0	-94	Loc_na
1	AIRTEL	4G	upload	4545.0	NaN	Loc_na
2	AIRTEL	4G	upload	7053.0	-86	Haryana
3	AIRTEL	4G	upload	15713.0	-86	Haryana
4	AIRTEL	4G	upload	25746.0	-95	Loc_na
5	AIRTEL	4G	upload	6629.0	-87	Loc_na
6	AIRTEL	4G	upload	9603.0	-90	Loc_na
7	AIRTEL	4G	upload	97.0	-98	Loc_na
8	AIRTEL	4G	upload	8939.0	-92	Loc_na
9	AIRTEL	4G	upload	8918.0	-92	Loc_na

In [15]:
```
## Remove null values from speed column

myspeed.dropna(inplace=True)
```

In [16]:
```
## Change datatype of signal strength from object to float

myspeed['signal_strength']= myspeed['signal_strength'].astype('float64')
```

In [17]:
```
myspeed.dtypes
```

Out[17]:
```
operator            object
technology          object
download            object
speed              float64
signal_strength    float64
lsa                 object
dtype: object
```

In [18]:
```
myspeed.isnull().sum()
```

Out[18]:
```
operator           0
technology         0
download           0
speed              0
signal_strength    0
lsa                0
dtype: int64
```

In [19]:
```
myspeed.shape
```

Out[19]:
```
(893390, 6)
```

In [20]:
```
myspeed.head(10)
```

Out[20]:

	operator	technology	download	speed	signal_strength	lsa
0	AIRTEL	4G	download	33873.0	-94.0	Loc_na
2	AIRTEL	4G	upload	7053.0	-86.0	Haryana
3	AIRTEL	4G	upload	15713.0	-86.0	Haryana
4	AIRTEL	4G	upload	25746.0	-95.0	Loc_na
5	AIRTEL	4G	upload	6629.0	-87.0	Loc_na
6	AIRTEL	4G	upload	9603.0	-90.0	Loc_na
7	AIRTEL	4G	upload	97.0	-98.0	Loc_na
8	AIRTEL	4G	upload	8939.0	-92.0	Loc_na
9	AIRTEL	4G	upload	8918.0	-92.0	Loc_na
10	AIRTEL	4G	upload	7406.0	-96.0	Loc_na

Check for outliers

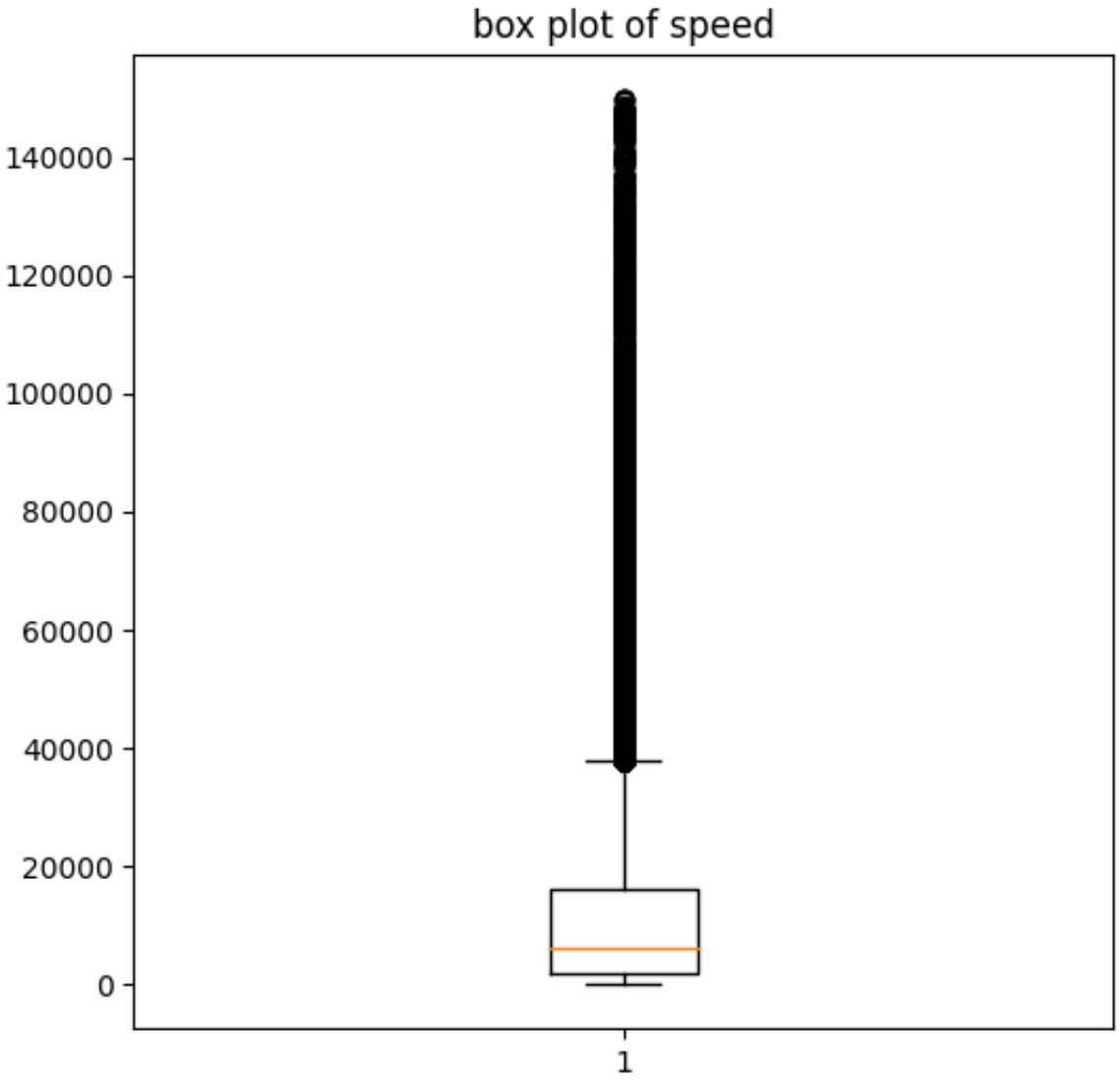
In [21]:
```
myspeed.describe()
```

Out[21]:

	speed	signal_strength
count	893390.000000	893390.000000
mean	11576.044900	-93.839694
std	14820.062552	11.311179
min	1.000000	-112.000000
25%	1779.000000	-103.000000
50%	6027.000000	-95.000000
75%	16195.000000	-87.000000
max	149716.000000	-50.000000

In [22]:
```
plt.figure(figsize=(6,6))
plt.boxplot(data=myspeed, x='speed')
plt.title('box plot of speed')
```

Out[22]:
```
Text(0.5, 1.0, 'box plot of speed')
```



In [23]:
```
## According to the Bharti Airtel expert 4G speed can go upto 100 mbps or
## Similarly according to wikipedia lowest speed of 3G is 144 kbps.
## So, anything outside this range will be outlier for us.

myspeed= myspeed[myspeed['speed']<100000]
myspeed= myspeed[myspeed['speed']>144]

myspeed
```

Out[23]:

	operator	technology	download	speed	signal_strength	lsa
0	AIRTEL	4G	download	33873.0	-94.0	Loc_na
2	AIRTEL	4G	upload	7053.0	-86.0	Haryana
3	AIRTEL	4G	upload	15713.0	-86.0	Haryana
4	AIRTEL	4G	upload	25746.0	-95.0	Loc_na
5	AIRTEL	4G	upload	6629.0	-87.0	Loc_na
...	...	...	...	...	...	...
957971	AIRTEL	4G	download	21126.0	-81.0	Loc_na
957972	AIRTEL	4G	download	22196.0	-95.0	Loc_na
957973	AIRTEL	4G	download	17356.0	-107.0	Loc_na
957974	AIRTEL	4G	download	593.0	-91.0	Loc_na
957975	AIRTEL	4G	download	2386.0	-94.0	Loc_na

860837 rows × 6 columns

Data Analysis and Visulaization

In [24]:
```
myspeed.describe()
```

Out[24]:

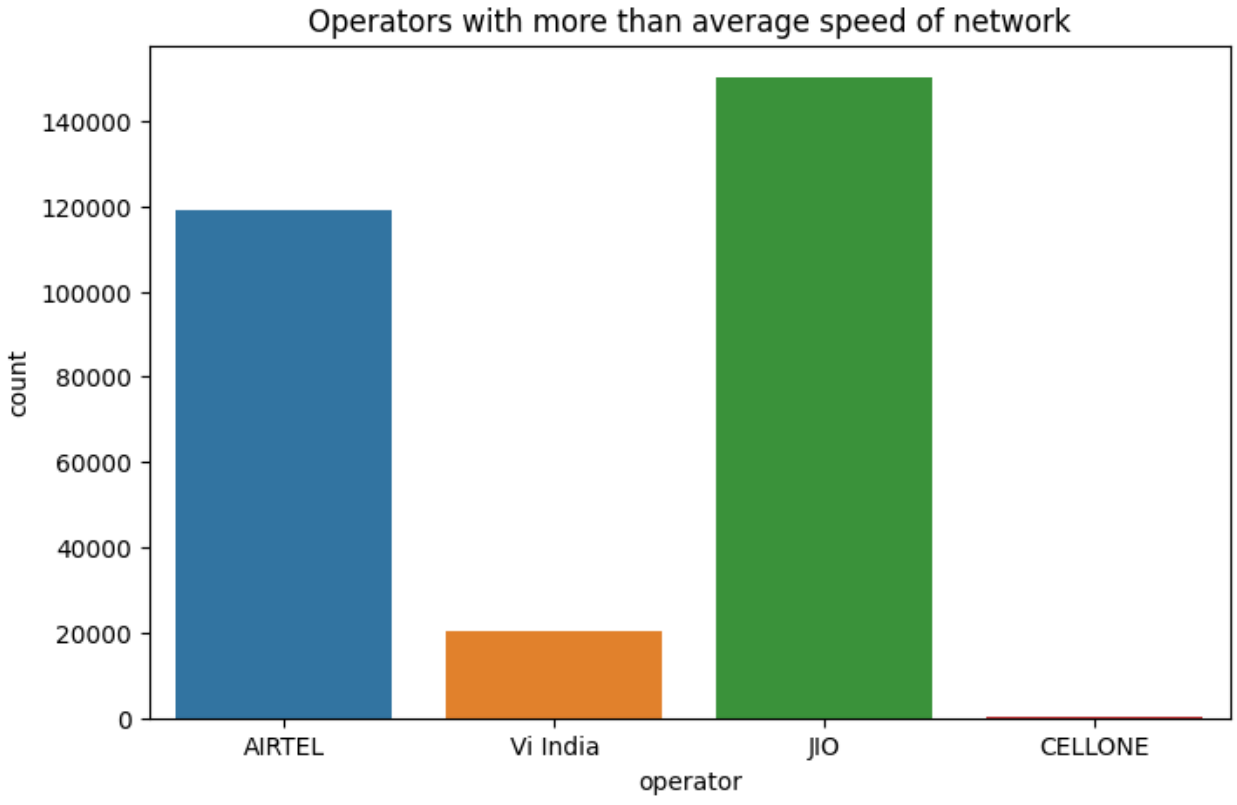
	speed	signal_strength
count	860837.000000	860837.000000
mean	11900.888072	-93.681345
std	14569.755099	11.311117
min	145.000000	-112.000000
25%	2077.000000	-103.000000
50%	6463.000000	-95.000000
75%	16716.000000	-87.000000
max	99999.000000	-50.000000

In [25]:
```
## calculate average speed of network and plot a graph of operators who h
avg_speed= round(myspeed['speed'].mean(),2)
print('Average speed', avg_speed)
print('-'*25)

plt.figure(figsize=(8,5))
sns.countplot(data=myspeed[myspeed['speed']>avg_speed], x='operator')
plt.title('Operators with more than average speed of network')
```

```
Average speed 11900.89
-------------------------
```

Out[25]: Text(0.5, 1.0, 'Operators with more than average speed of network')



Here JIO is clear winner in terms of network speed followed by Airtel

In [26]:
```
## Average signal strength according to operators
mean_signal_strength= pd.DataFrame(round(myspeed.groupby(by= 'operator')[
mean_signal_strength
```

Out[26]:

operator	signal_strength
AIRTEL	-94.80
CELLONE	-81.05
JIO	-92.71
Vi India	-96.07

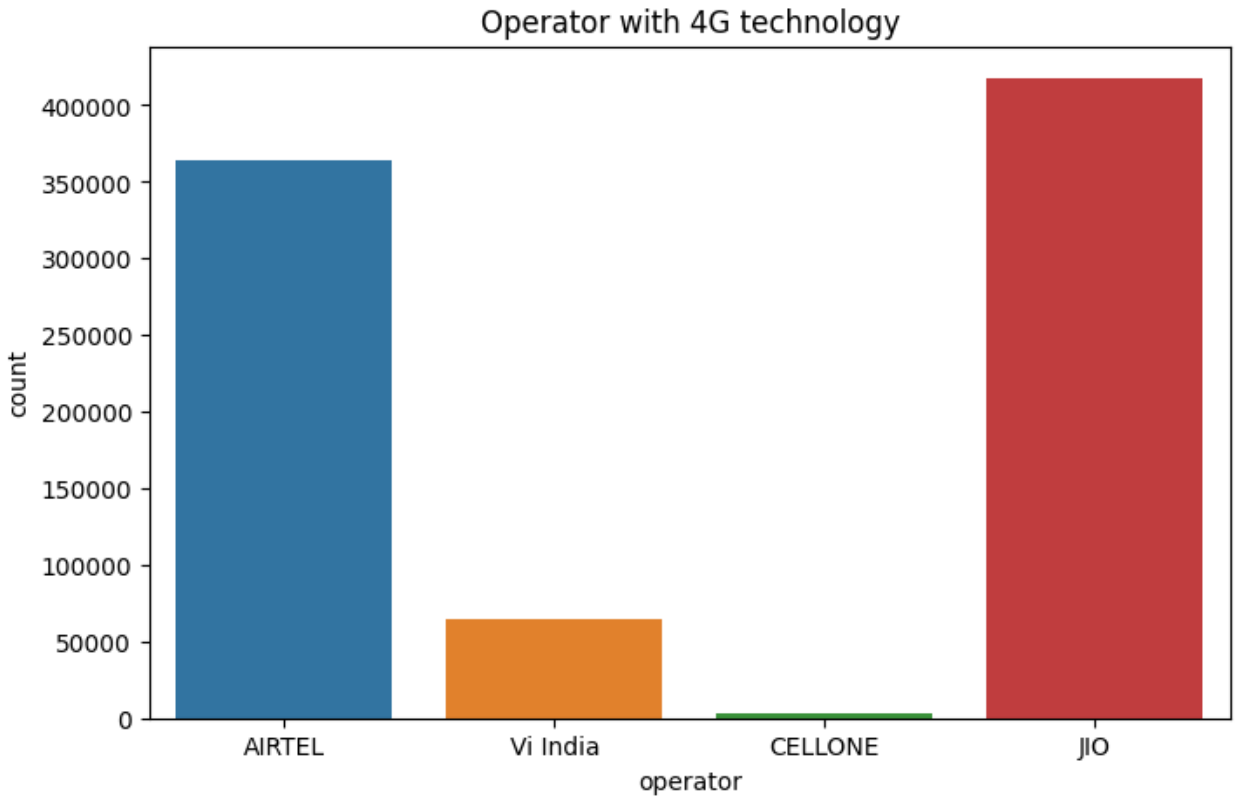
CELLONE give the best signal strength followed by JIO

In [27]:
```
## calculate percentage, operators with 4G technology
tech_4G = myspeed[myspeed['technology']== '4G']
print('percentage count of',round(tech_4G['operator'].value_counts(normal
print('-'*25)

plt.figure(figsize=(8,5))
sns.countplot(data=tech_4G, x='operator')
plt.title('Operator with 4G technology')
```

```
percentage count of operator
JIO         0.49
AIRTEL      0.43
Vi India    0.08
CELLONE     0.00
Name: proportion, dtype: float64
-------------------------
```

Out[27]: Text(0.5, 1.0, 'Operator with 4G technology')



JIO with highest 4G technology followed by Airtel

According to the given parameters JIO is clean winner, hence JIO is the best network provider in Dec 2021