Step1: Importing and Cleaning the Data

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

internet_usage = pd.read_csv('E:\!DataScience_DSPP_JNTU\Assignments\ML_AL\ML_DL_Assignment_1\internet_session.csv', parse_dates=
```

In [3]:
```
internet_usage
```

Out[3]:

	name	start_time	usage_time	IP	MAC	upload	download	total_transfer	seession_break_reason
0	user1	2022-05-10 02:59:32	00:00:36:28	10.55.14.222	48:E7:DA:58:22:E9	15861.76	333168.64	349030.40	Idle-Timeout
1	user1	2022-05-10 18:53:27	00:01:49:56	10.55.2.253	48:E7:DA:58:22:E9	16957.44	212152.32	229109.76	Idle-Timeout
2	user1	2022-05-10 21:20:44	00:01:35:00	10.55.2.253	48:E7:DA:58:22:E9	14080.0	195153.92	209233.92	Idle-Timeout
3	user1	2022-05-11 00:37:42	00:00:26:00	10.55.2.253	48:E7:DA:58:22:E9	5242.88	40806.4	46049.28	Idle-Timeout
4	user1	2022-05-11 02:59:38	00:00:11:52	10.55.2.253	48:E7:DA:58:22:E9	22067.2	10772.48	32839.68	Idle-Timeout
...	...	...	...	...	...	...	...	...	...
4707	user9	2022-11-04 01:11:34	00:06:54:32	10.55.4.189	DA:2F:97:0E:B7:D0	107960.32	2390753.28	2495610.88	Idle-Timeout
4708	user9	2022-11-04 10:26:09	00:00:23:49	10.55.4.59	DA:2F:97:0E:B7:D0	11407.36	209674.24	221081.60	Idle-Timeout
4709	user9	2022-11-04 20:41:42	00:01:24:13	10.55.15.186	DA:2F:97:0E:B7:D0	18995.2	373657.6	392652.80	Idle-Timeout
4710	user9	2022-11-05 00:21:06	00:08:49:43	10.55.4.159	DA:2F:97:0E:B7:D0	46602.24	593766.4	640368.64	Idle-Timeout
4711	user9	2022-11-05 20:55:37	00:01:06:20	10.55.2.33	DA:2F:97:0E:B7:D0	21237.76	298536.96	319774.72	NaN

4712 rows × 9 columns

In [4]:
```
internet_usage.shape
```

Out[4]:
```
(4712, 9)
```

Dataset contains 4712 rows and 9 columns

In [5]:
```
internet_usage.columns
```

Out[5]:
```
Index(['name', 'start_time', 'usage_time', 'IP', 'MAC', 'upload', 'download',
       'total_transfer', 'seession_break_reason'],
      dtype='object')
```

Columns Index is not in uniform Case. Need to bring all of them in lower case columns

In [6]:
```
internet_usage.columns = internet_usage.columns.str.lower()
```

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

Out[7]:
```
Index(['name', 'start_time', 'usage_time', 'ip', 'mac', 'upload', 'download',
       'total_transfer', 'seession_break_reason'],
      dtype='object')
```

Need to check in the data as noticed 'null' values in the input data and drop them if unnecessary.

In [8]:
```
internet_usage.isna().sum()
```

Out[8]:
```
name                    0
start_time              0
usage_time              0
ip                      0
mac                     0
upload                  0
download                0
total_transfer          0
seession_break_reason    9
dtype: int64
```

Column "seession_break_reason" has 9 null values that is very low count. As it doesn't affect our analysis, therefore can safely delete them.

In [9]:
```
internet_usage = internet_usage.dropna().copy()
```

In [10]:
```
internet_usage.isna().sum()
```

Out[10]:
```
name                    0
start_time              0
usage_time              0
ip                      0
mac                     0
upload                  0
download                0
total_transfer          0
seession_break_reason   0
dtype: int64
```

In [11]:
```
internet_usage.duplicated().sum()
```

Out[11]:
```
0
```

In [12]:
```
internet_usage.dtypes
```

Out[12]:
```
name                            object
start_time              datetime64[ns]
usage_time                      object
ip                              object
mac                             object
upload                          object
download                        object
total_transfer                 float64
seession_break_reason           object
dtype: object
```

Columns are in wrong data type and requires fixing

In [13]:
```
internet_usage['usage_time'] = internet_usage['usage_time'].str.replace('00:', '', 1)
internet_usage['usage_time'] = pd.to_datetime(internet_usage['usage_time'])

internet_usage['upload'] = internet_usage['upload'].str.extract('(\d+)', expand=False)
internet_usage.upload = internet_usage.upload.astype(float)

internet_usage['download'] = internet_usage['download'].str.extract('(\d+)', expand=False)
internet_usage.download = internet_usage.download.astype(float)

device = []
basename = 'device'
mac = internet_usage['mac'][0]
device_number = 1
```

```
for i in internet_usage['mac']:
    if i == mac:
        device.append(basename + str(device_number))
    else:
        device_number += 1
        device.append(basename + str(device_number))
        mac = i
internet_usage['device'] = device

internet_usage.dtypes
```

Out[13]:
```
name                          object
start_time               datetime64[ns]
usage_time               datetime64[ns]
ip                            object
mac                           object
upload                       float64
download                     float64
total_transfer               float64
seession_break_reason         object
device                        object
dtype: object
```

Step2 - Exploratory Data Analysis

calculating some descriptive statistics

In [14]:
```
internet_usage.describe(include='all', datetime_is_numeric=True)
```

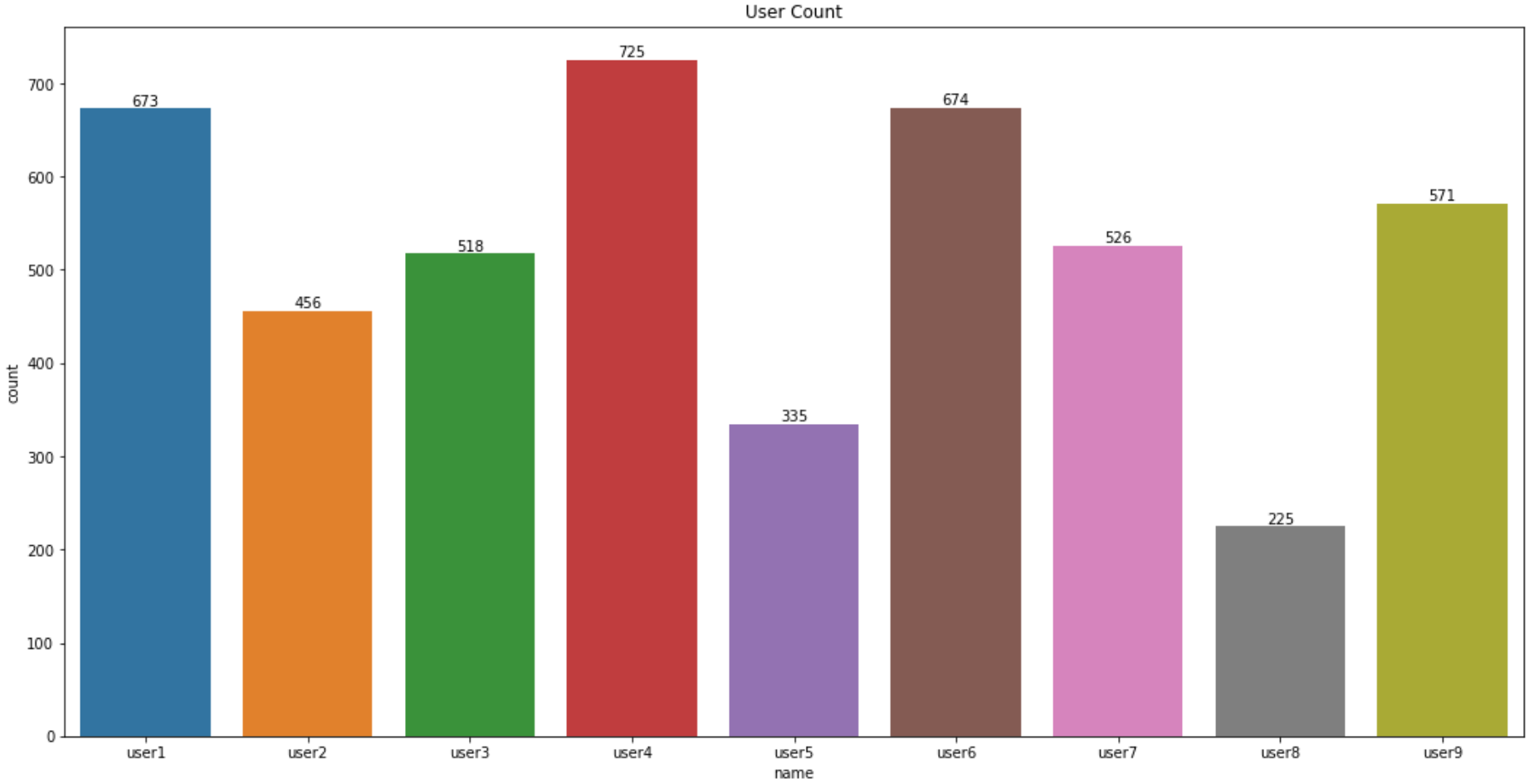
Out[14]:

	name	start_time	usage_time	ip	mac	upload	download	total_transfer	seession_break_reason	
count	4703	4703	4703	4703	4703	4.703000e+03	4.703000e+03	4.703000e+03	4703	
unique	9	NaN	NaN	1299	33	NaN	NaN	NaN	5	
top	user4	NaN	NaN	10.55.0.89	48:E7:DA:58:22:E9	NaN	NaN	NaN	Idle-Timeout	dev
freq	725	NaN	NaN	80	1235	NaN	NaN	NaN	4350	
mean	NaN	2022-08-08 09:35:44.875185920	2023-02-01 02:10:05.038486016	NaN	NaN	3.378702e+04	3.966645e+05	4.304372e+05	NaN	
min	NaN	2022-05-09 22:52:41	2023-02-01 00:00:01	NaN	NaN	2.000000e+00	9.000000e+00	1.120000e+00	NaN	
25%	NaN	2022-06-14 18:33:06.500000	2023-02-01 00:31:42	NaN	NaN	6.082000e+03	5.199800e+04	6.187008e+04	NaN	
50%	NaN	2022-08-19 13:56:28	2023-02-01 01:19:40	NaN	NaN	1.531900e+04	1.782680e+05	2.027930e+05	NaN	
75%	NaN	2022-09-24 22:30:58.500000	2023-02-01 02:49:02	NaN	NaN	3.399600e+04	4.593660e+05	4.993997e+05	NaN	
max	NaN	2022-11-05 18:41:14	2023-02-01 22:00:07	NaN	NaN	2.841640e+06	2.790261e+07	2.855272e+07	NaN	
std	NaN	NaN	NaN	NaN	NaN	9.493243e+04	9.657778e+05	9.960848e+05	NaN	

In [15]:
```
### From the above, we can see there are 9 users. Let's see the counts of users.
internet_usage.name.value_counts()
```

Out[15]:
```
user4    725
user6    674
user1    673
user9    571
user7    526
user3    518
user2    456
user5    335
user8    225
Name: name, dtype: int64
```

In [16]:
```
plt.figure(figsize=(18, 9))
ax = sns.countplot(x='name', data=internet_usage)
ax.bar_label(ax.containers[0])
plt.title("User Count")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

Above plots shows, User4 the most with a count of 725, while user8 was the least represented with a count of 225

In [17]:
```
print('The earliest start time is:')
print(internet_usage.start_time.min())
```

```
print('The latest start time is:')
print(internet_usage.start_time.max())
```

```
The earliest start time is:
2022-05-09 22:52:41
The latest start time is:
2022-11-05 18:41:14
```

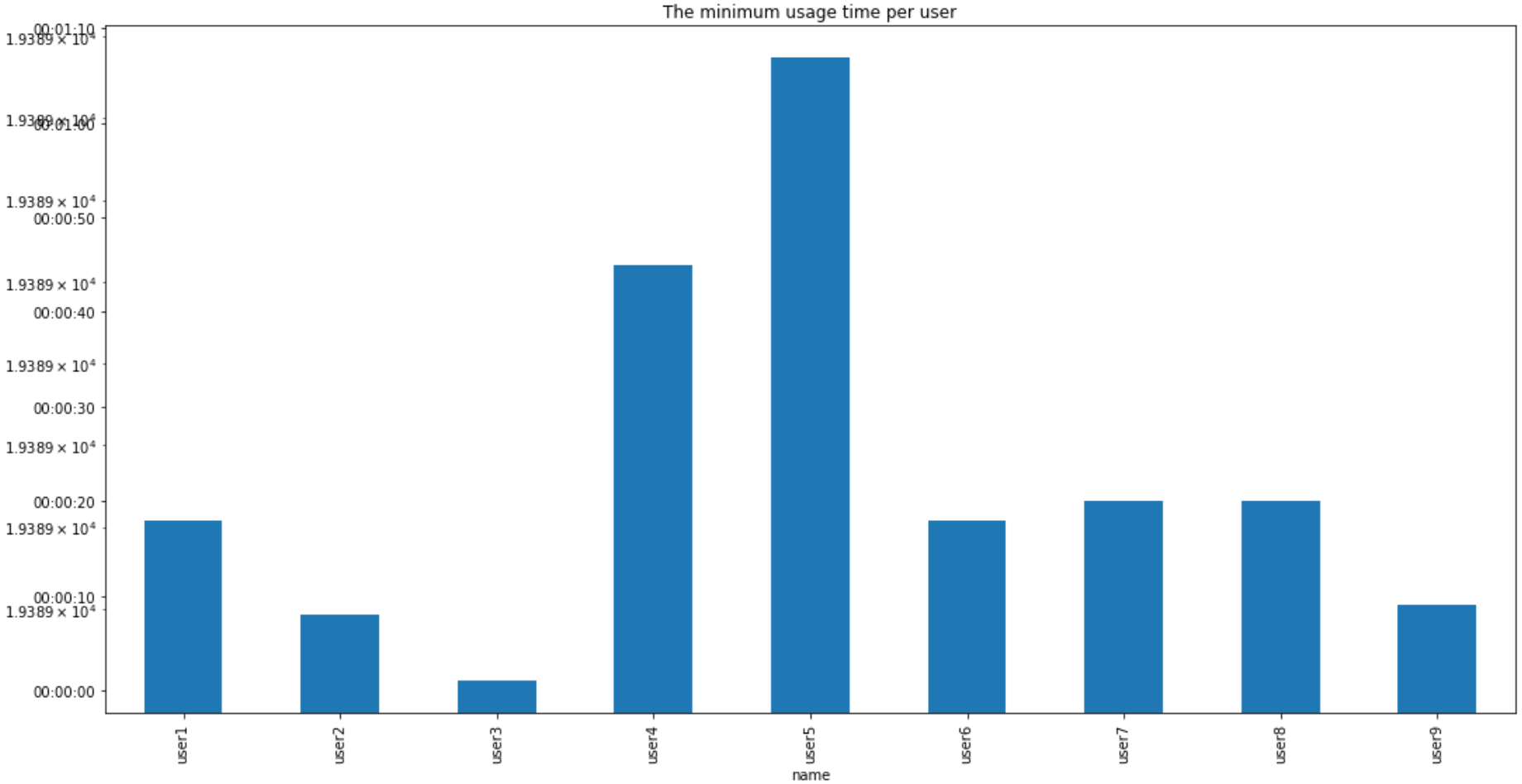
In [18]:
```
print('The minimum usage time is:')
print(internet_usage.usage_time.min())
print('The maximum usage time is:')
print(internet_usage.usage_time.max())
print('The average usage time is:')
print(internet_usage.usage_time.mean())
```

```
The minimum usage time is:
2023-02-01 00:00:01
The maximum usage time is:
2023-02-01 22:00:07
The average usage time is:
2023-02-01 02:10:05.038486016
```

In [19]:
```
print('The minimum usage time per user:')
usage_time_minimum = internet_usage.groupby('name').usage_time.min()
usage_time_minimum
```

Out[19]:
```
The minimum usage time per user:
name
user1   2023-02-01 00:00:18
user2   2023-02-01 00:00:08
user3   2023-02-01 00:00:01
user4   2023-02-01 00:00:45
user5   2023-02-01 00:01:07
user6   2023-02-01 00:00:18
user7   2023-02-01 00:00:20
user8   2023-02-01 00:00:20
user9   2023-02-01 00:00:09
Name: usage_time, dtype: datetime64[ns]
```

In [20]:
```
plt.figure(figsize=(18, 9))
usage_time_minimum.plot(kind='bar', logy=True)
plt.title("The minimum usage time per user")
plt.show()
plt.clf()
```



<Figure size 432x288 with 0 Axes>

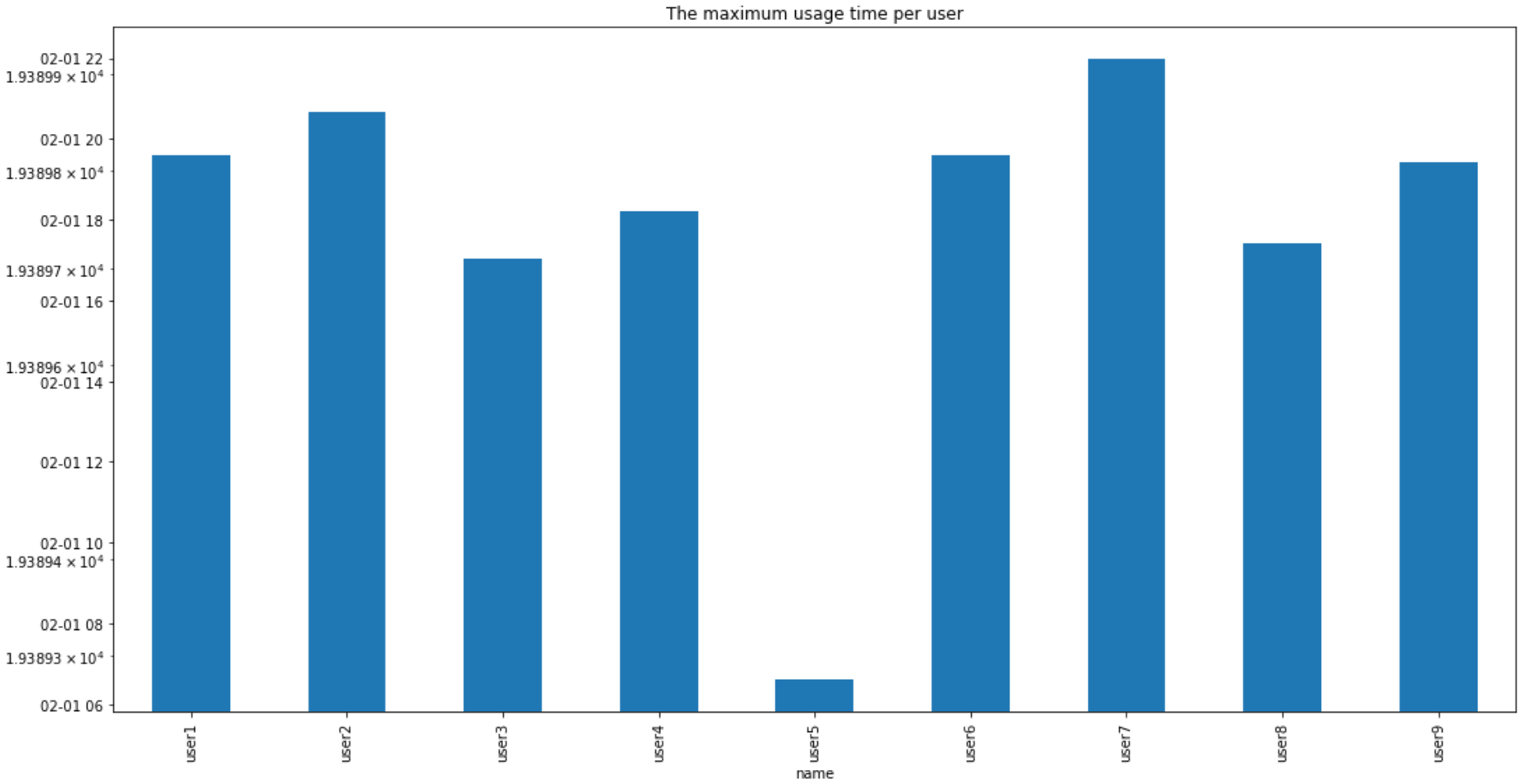
User3 has the least amount of minimum usage with 1 second, while user5 has the greatest with more than a minute and 7 seconds

In [21]:
```
print('The maximum usage time per user:')
usage_time_maximum = internet_usage.groupby('name').usage_time.max()
usage_time_maximum
```

```
The maximum usage time per user:
```

Out[21]:
```
name
user1   2023-02-01 19:35:11
user2   2023-02-01 20:39:52
user3   2023-02-01 17:01:28
user4   2023-02-01 18:11:43
user5   2023-02-01 06:36:11
user6   2023-02-01 19:35:11
user7   2023-02-01 22:00:07
user8   2023-02-01 17:24:26
user9   2023-02-01 19:26:09
Name: usage_time, dtype: datetime64[ns]
```

In [22]:
```
plt.figure(figsize=(18, 9))
usage_time_maximum.plot(kind='bar', logy=True)
plt.title("The maximum usage time per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

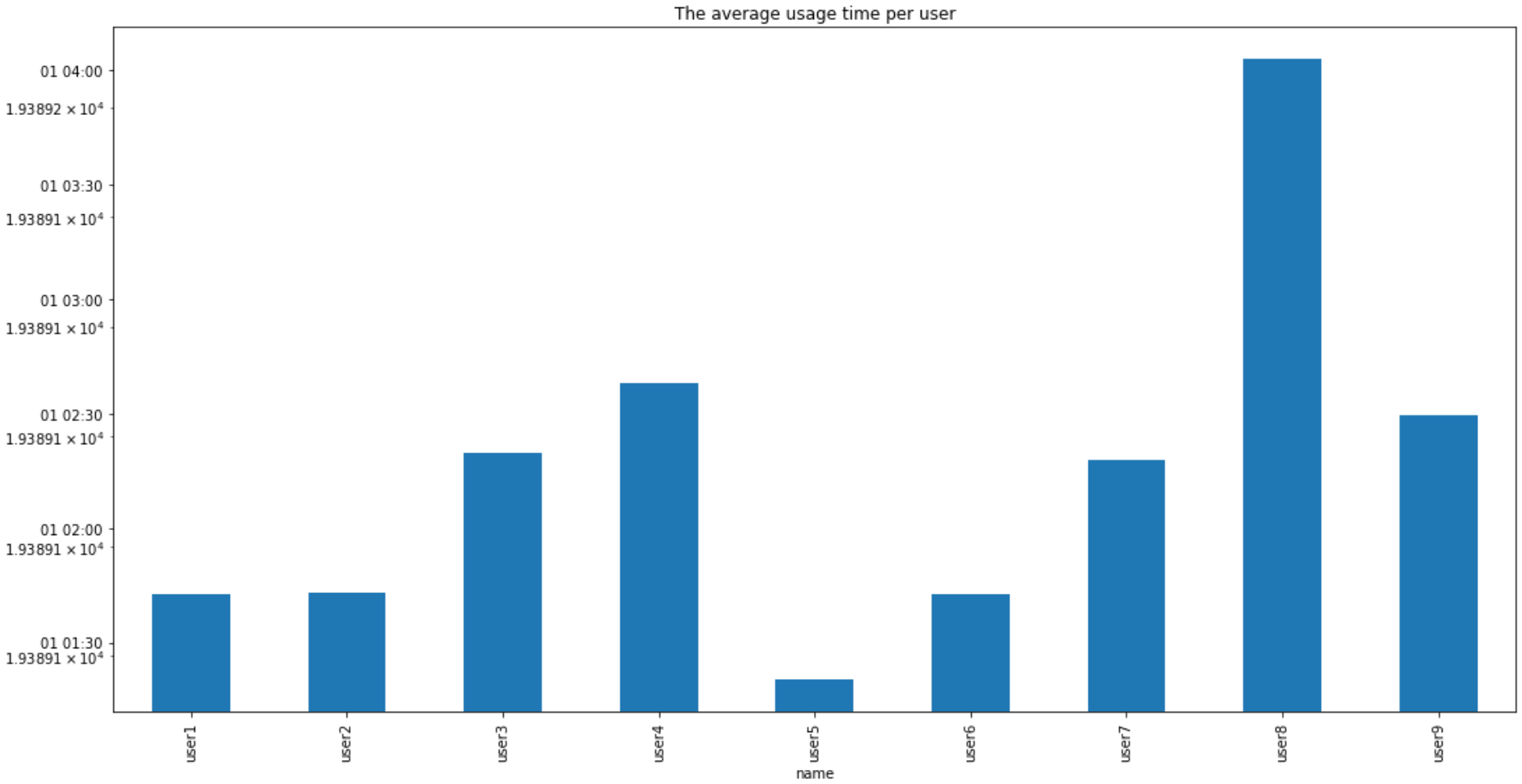
user7 has the greatest maximum time usage with 22 hours and 7 seconds, while user5 has the least amount with only 6 hours 36 minutes and 11 seconds

In [23]:
```
print('The average usage time per user:')
usage_time_average = internet_usage.groupby('name').usage_time.mean()
usage_time_average
```

```
The average usage time per user:
```

Out[23]:
```
name
user1   2023-02-01 01:42:47.665676032
user2   2023-02-01 01:42:53.866227968
user3   2023-02-01 02:19:42.019305216
user4   2023-02-01 02:38:01.766896640
user5   2023-02-01 01:20:11.701492736
user6   2023-02-01 01:42:49.998516224
user7   2023-02-01 02:17:45.053231872
user8   2023-02-01 04:03:14.555555584
user9   2023-02-01 02:29:32.180385280
Name: usage_time, dtype: datetime64[ns]
```

In [24]:
```
plt.figure(figsize=(18, 9))
usage_time_average.plot(kind='bar', logy=True)
plt.title("The average usage time per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

Above average time and figure shows on hours of usage i.e., User8 has the most usage with 4 hours 3 minutes and 14 seconds, while User5 with 1 hour 20 minutes and 11 seconds

In [25]:
```
internet_usage.ip.value_counts()
```

Out[25]:
```
10.55.0.89      80
10.55.14.148    64
10.55.15.221    55
10.55.1.50      48
10.55.10.46     44
                ..
10.55.15.44      1
10.55.15.237     1
10.55.14.166     1
10.55.3.200      1
10.55.4.159      1
Name: ip, Length: 1299, dtype: int64
```

Most used IP Adress is 10:55:0:89 with 80 count

In [26]:
```
internet_usage.device.value_counts()
```

Out[26]:
```
device1206    194
device835     137
device11      137
device1212    132
device312     113
              ...
device582       1
device583       1
device584       1
device585       1
device613       1
Name: device, Length: 1224, dtype: int64
```

Most used device is device 1206 with 194 times

In [27]:
```
print('The minimum upload is: ' + str(internet_usage.upload.min()) + 'Kb')
print('The maximum upload is: ' + str(internet_usage.upload.max()) + 'Kb')
print('The average upload is: ' + str(round(internet_usage.upload.mean(), 2)) + 'Kb')
```

```
The minimum upload is: 2.0Kb
The maximum upload is: 2841640.0Kb
The average upload is: 33787.02Kb
```

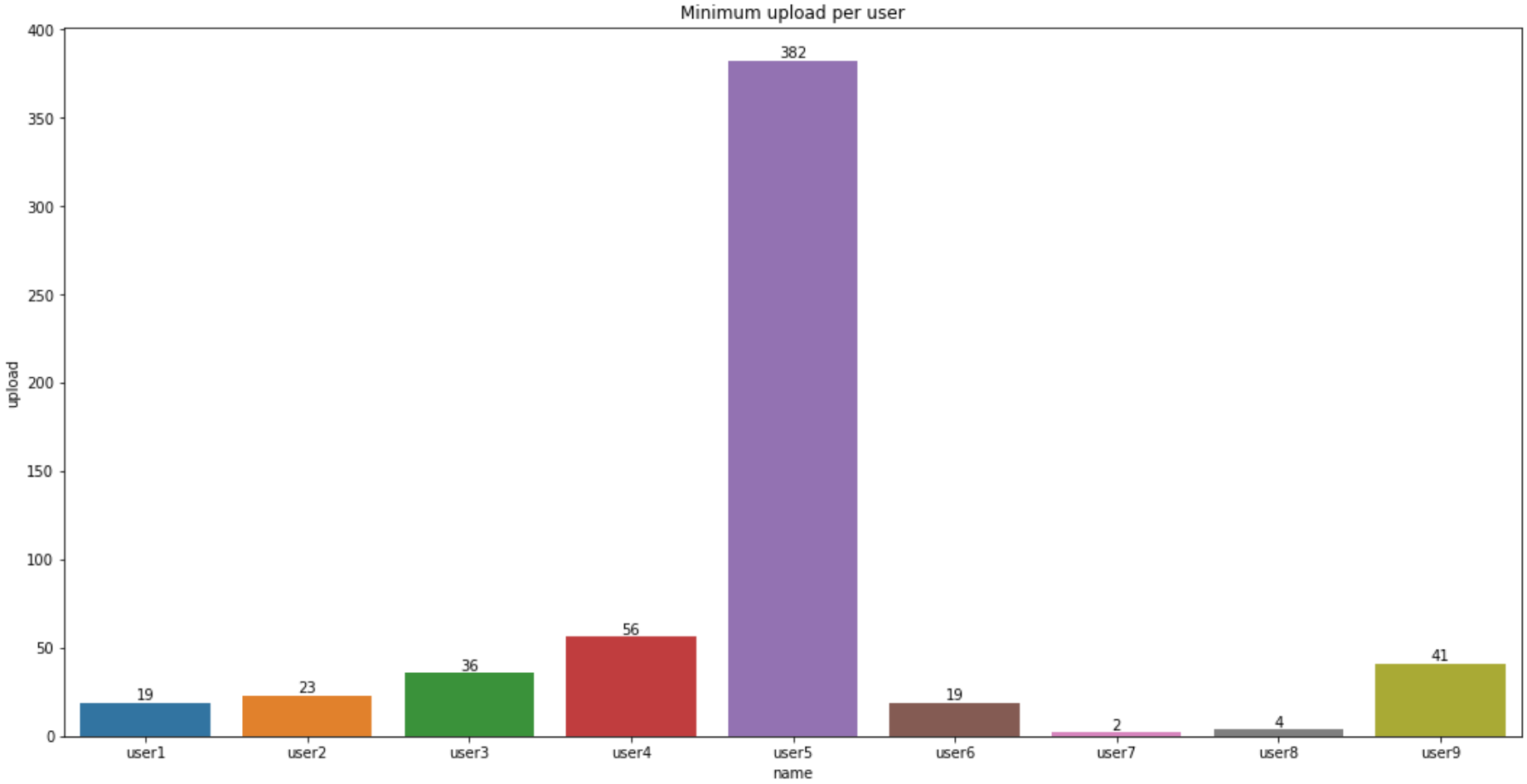
Now will check the minimum, maximum and average upload per user

==> Minimum upload per user

In [28]:
```
print('The minimum upload per user:')
internet_usage.groupby('name').upload.min()
```

Out[28]:
```
The minimum upload per user:
name
user1     19.0
user2     23.0
user3     36.0
user4     56.0
user5    382.0
user6     19.0
user7      2.0
user8      4.0
user9     41.0
Name: upload, dtype: float64
```

In [29]:
```
plt.figure(figsize=(18, 9))
ax = sns.barplot(x='name', y='upload' , data=internet_usage, ci=None, estimator=np.min)
ax.bar_label(ax.containers[0])
plt.title("Minimum upload per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

Referring above: user2 has the lowest minimum upload with 2Kb while user5 has the highest minimum upload with 382Kb

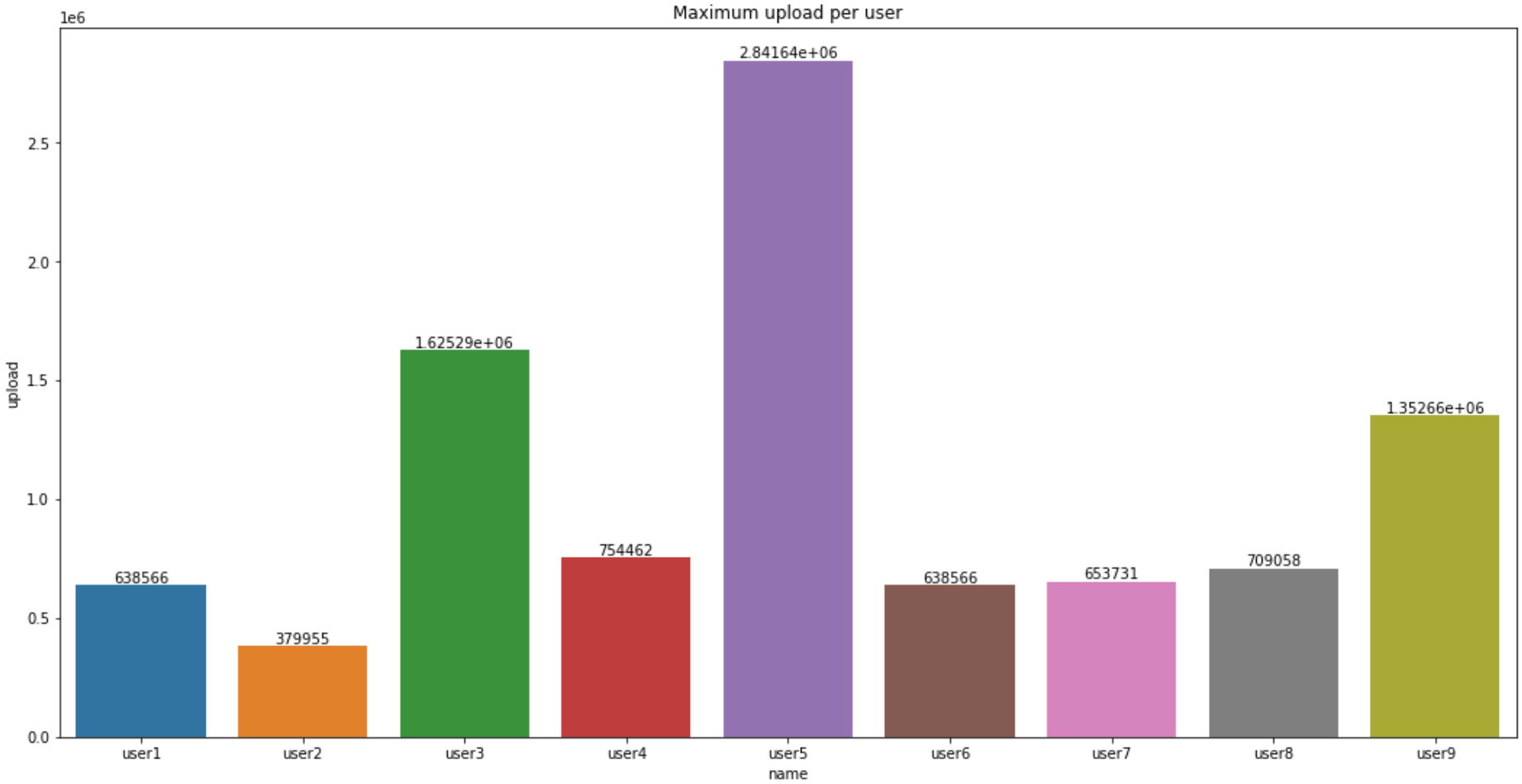
==> Maximum upload per user

In [30]:
```
print('The maximum upload per user:')
internet_usage.groupby('name').upload.max()
```

```
The maximum upload per user:
```

Out[30]:
```
name
user1     638566.0
user2     379955.0
user3    1625292.0
user4     754462.0
user5    2841640.0
user6     638566.0
user7     653731.0
user8     709058.0
user9    1352663.0
Name: upload, dtype: float64
```

In [31]:
```
plt.figure(figsize=(18, 9))
ax = sns.barplot(x='name', y='upload' , data=internet_usage, ci=None, estimator=np.max)
ax.bar_label(ax.containers[0])
plt.title("Maximum upload per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

Referring above: User5 has the highest maximum upload of 2841640Kb and user2 having the lowest of maximum upload of 379955Kb

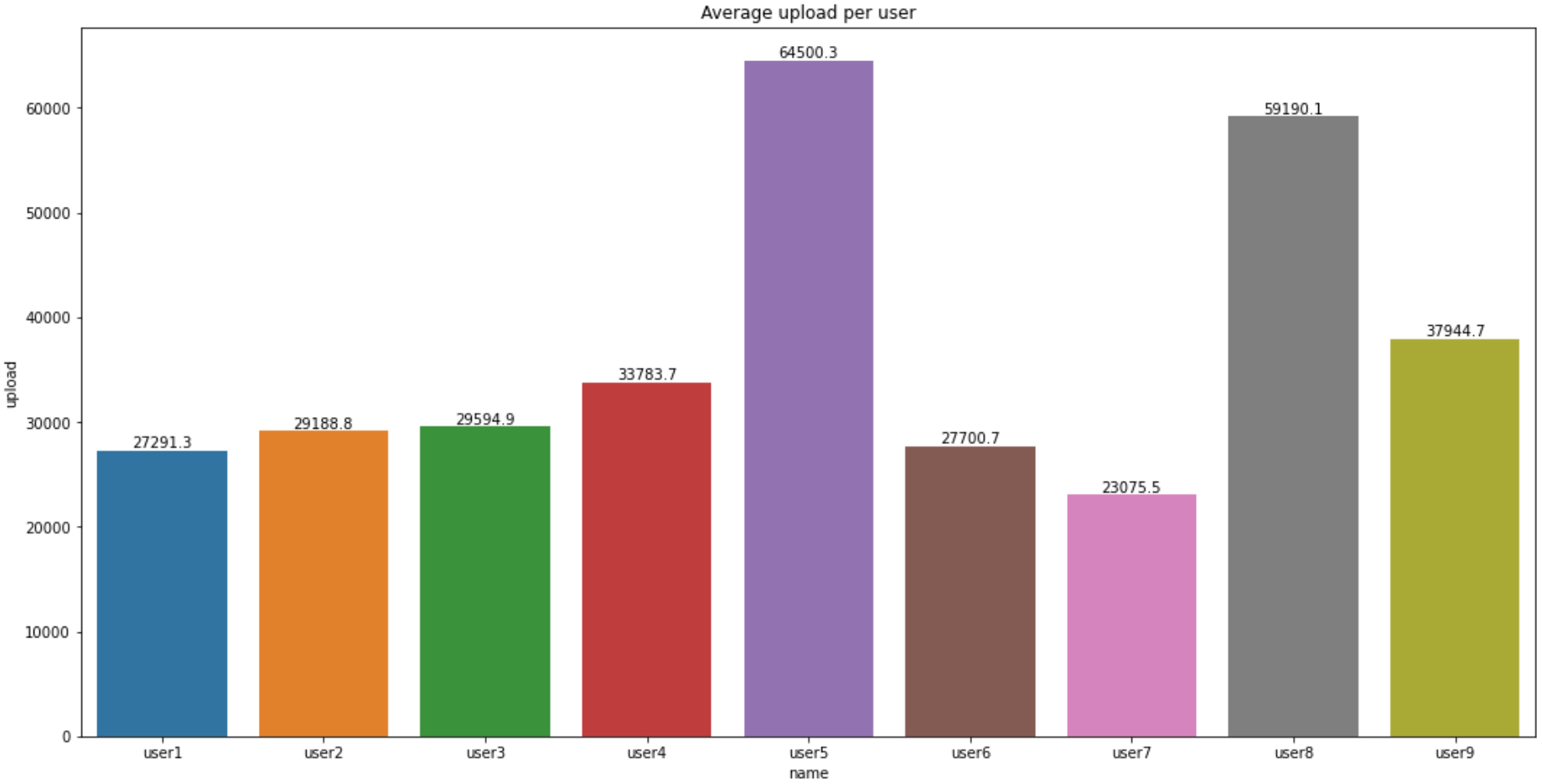
==> Average upload per user

In [32]:
```
print('The average upload per user:')
round(internet_usage.groupby('name').upload.mean(), 2)
```

```
The average upload per user:
```

Out[32]:
```
name
user1    27291.34
user2    29188.79
user3    29594.88
user4    33783.74
user5    64500.35
user6    27700.73
user7    23075.54
user8    59190.12
user9    37944.66
Name: upload, dtype: float64
```

In [33]:
```
plt.figure(figsize=(18, 9))
ax = sns.barplot(x='name', y='upload' , data=internet_usage, ci=None, estimator=np.mean)
ax.bar_label(ax.containers[0])
plt.title("Average upload per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

Referring above, User5 has the highest average upload with 64500.35Kb while User7 has the lower average with 23075.54Kb

Next Step, will do the same but for download, calculating minimum, maximum and average total and after that per user.

In [34]:
```
print('The minimum download is: ' + str(internet_usage.download.min()) + 'Kb')
print('The maximum download is: ' + str(internet_usage.download.max()) + 'Kb')
print('The average download is: ' + str(round(internet_usage.download.mean(), 2)) + 'Kb')
```

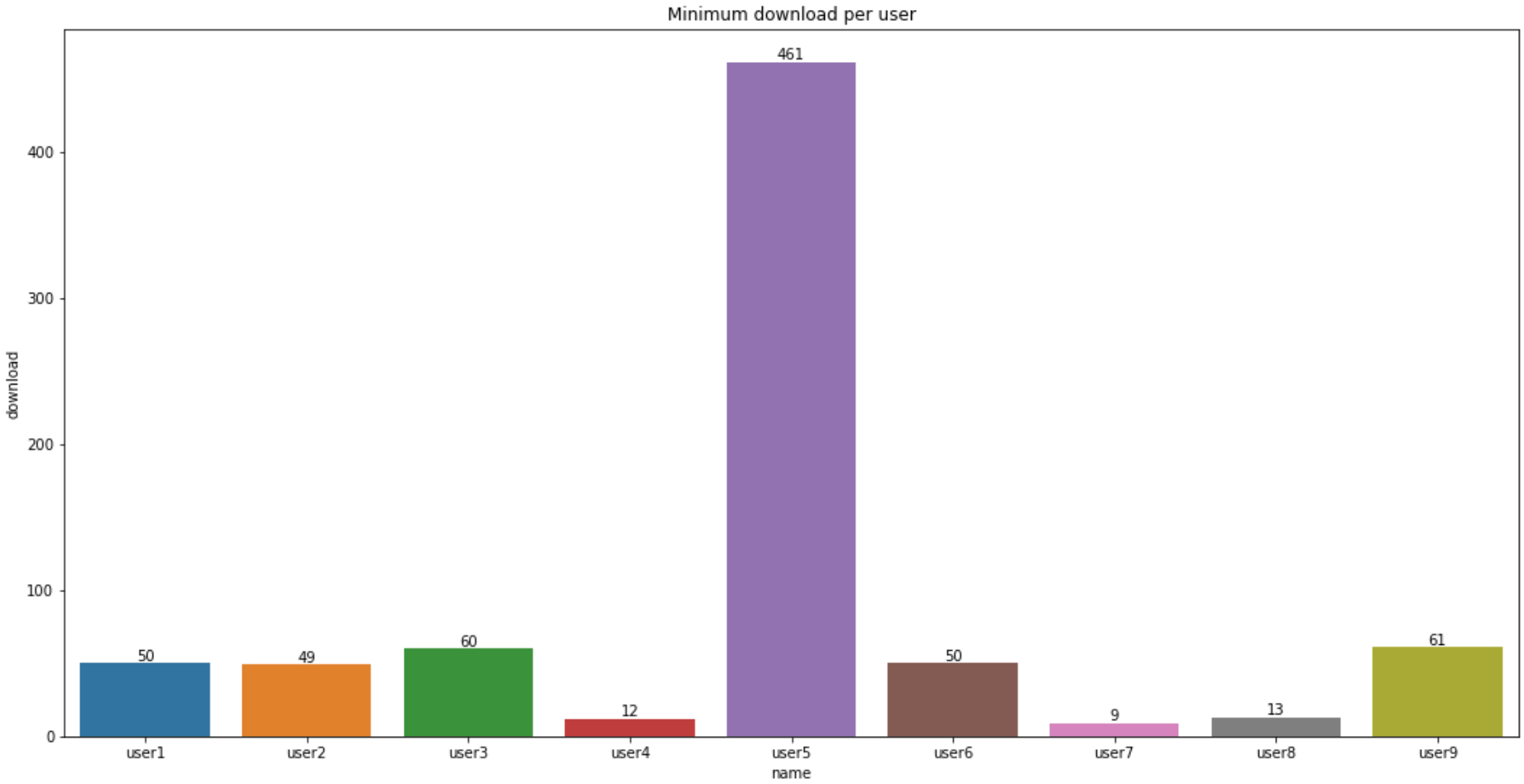
```
The minimum download is: 9.0Kb
The maximum download is: 27902607.0Kb
The average download is: 396664.52Kb
```

==> Download per user

In [35]:
```
print('The minimum download per user:')
internet_usage.groupby('name').download.min()
```

Out[35]:
```
The minimum download per user:
name
user1     50.0
user2     49.0
user3     60.0
user4     12.0
user5    461.0
user6     50.0
user7      9.0
user8     13.0
user9     61.0
Name: download, dtype: float64
```

In [36]:
```
plt.figure(figsize=(18, 9))
ax = sns.barplot(x='name', y='download' , data=internet_usage, ci=None, estimator=np.min)
ax.bar_label(ax.containers[0])
plt.title("Minimum download per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

Referring above, User5 has the highest minimum download with 461Kb while User7 has the lowest with 9Kb

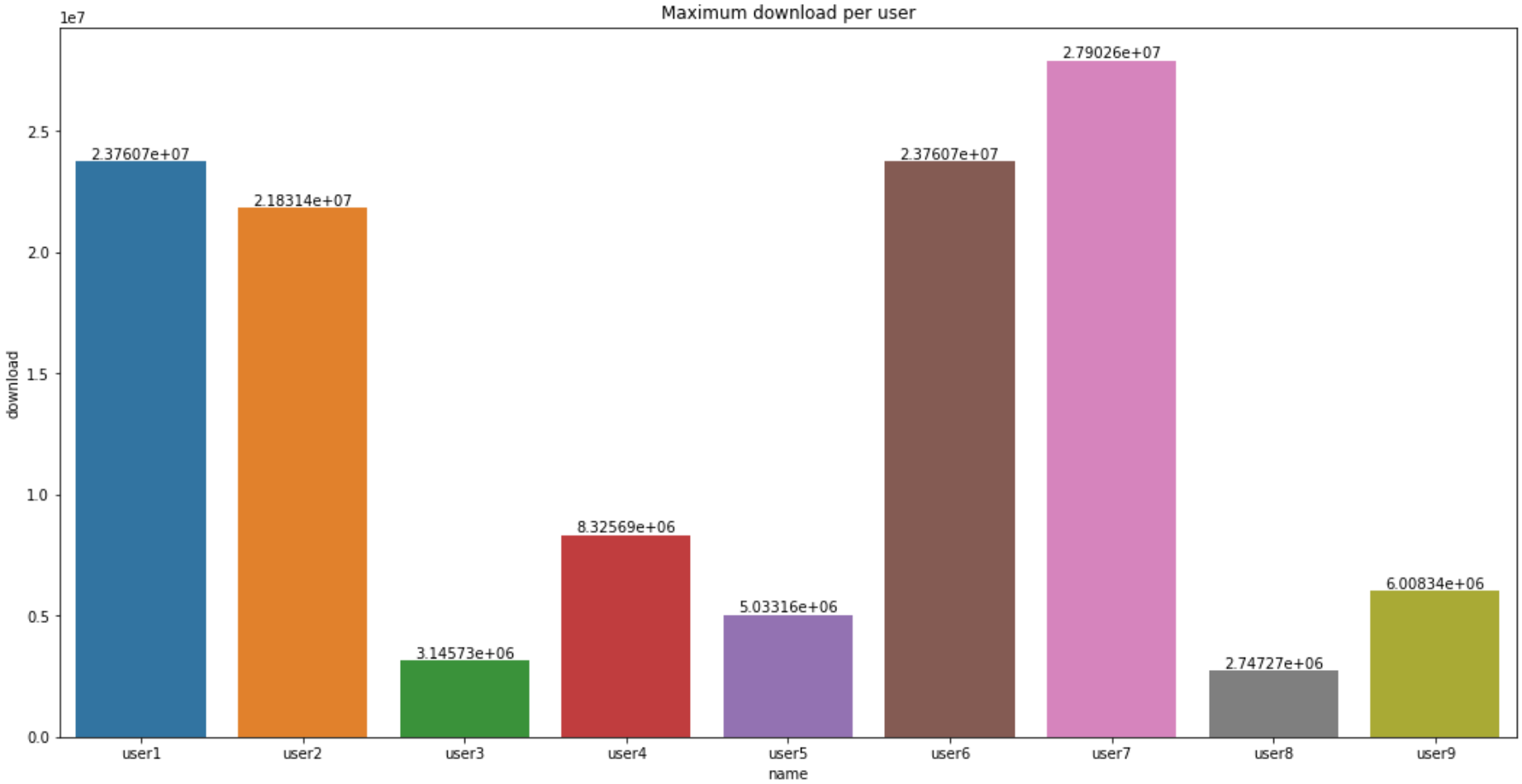
==> Maximum download per user

In [37]:
```
print('The maximum download per user:')
internet_usage.groupby('name').download.max()
```

```
The maximum download per user:
```

Out[37]:
```
name
user1    23760732.0
user2    21831352.0
user3     3145728.0
user4     8325693.0
user5     5033164.0
user6    23760732.0
user7    27902607.0
user8     2747269.0
user9     6008340.0
Name: download, dtype: float64
```

In [38]:
```
plt.figure(figsize=(18, 9))
ax = sns.barplot(x='name', y='download' , data=internet_usage, ci=None, estimator=np.max)
ax.bar_label(ax.containers[0])
plt.title("Maximum download per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

Referring above, User7 has the highest maximum download with 27902607Kb while user8 has the lowest with 2747269Kb

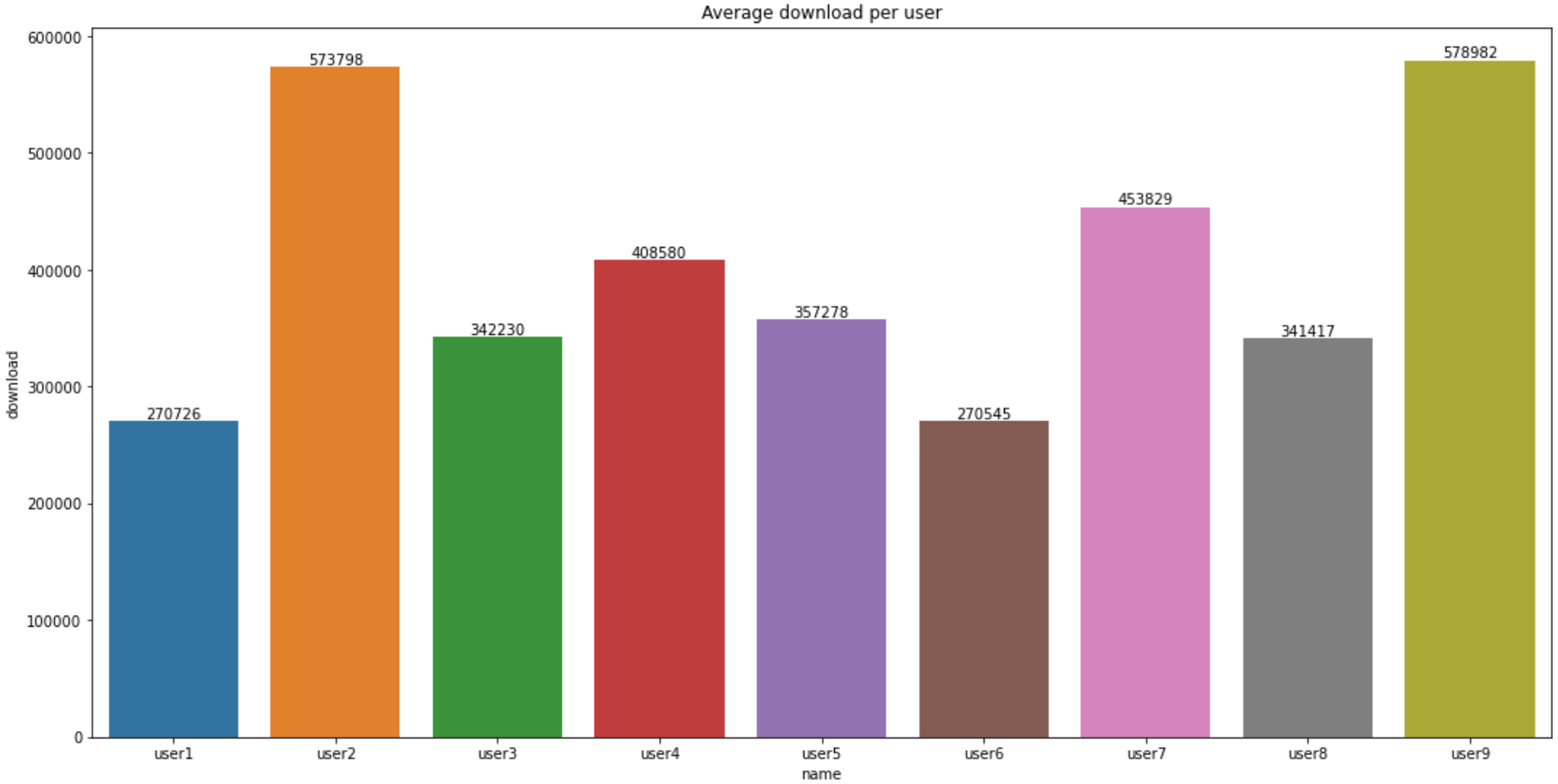
==> Average download per user

In [39]:
```
print('The average download per user:')
round(internet_usage.groupby('name').download.mean(), 2)
```

```
The average download per user:
```

Out[39]:
```
name
user1    270725.96
user2    573798.02
user3    342230.37
user4    408580.26
user5    357278.08
user6    270545.18
user7    453828.61
user8    341417.12
user9    578981.51
Name: download, dtype: float64
```

In [40]:
```
plt.figure(figsize=(18, 9))
ax = sns.barplot(x='name', y='download' , data=internet_usage, ci=None, estimator=np.mean)
ax.bar_label(ax.containers[0])
plt.title("Average download per user")
plt.show()
plt.clf()
```



<Figure size 432x288 with 0 Axes>

Referring above, User9 has the highest average download with 578982.51Kb while user6 has the lowest with 270545.18Kb

Now, will repeat all that with the total transfer column, minimum, maximum and average and than doing the same with each user

In [41]:
```
print('The minimum total transfer is: ' + str(internet_usage.total_transfer.min()) + 'Kb')
print('The maximum total transfer is: ' + str(internet_usage.total_transfer.max()) + 'Kb')
print('The average total transfer is: ' + str(round(internet_usage.total_transfer.mean(), 2)) + 'Kb')
```

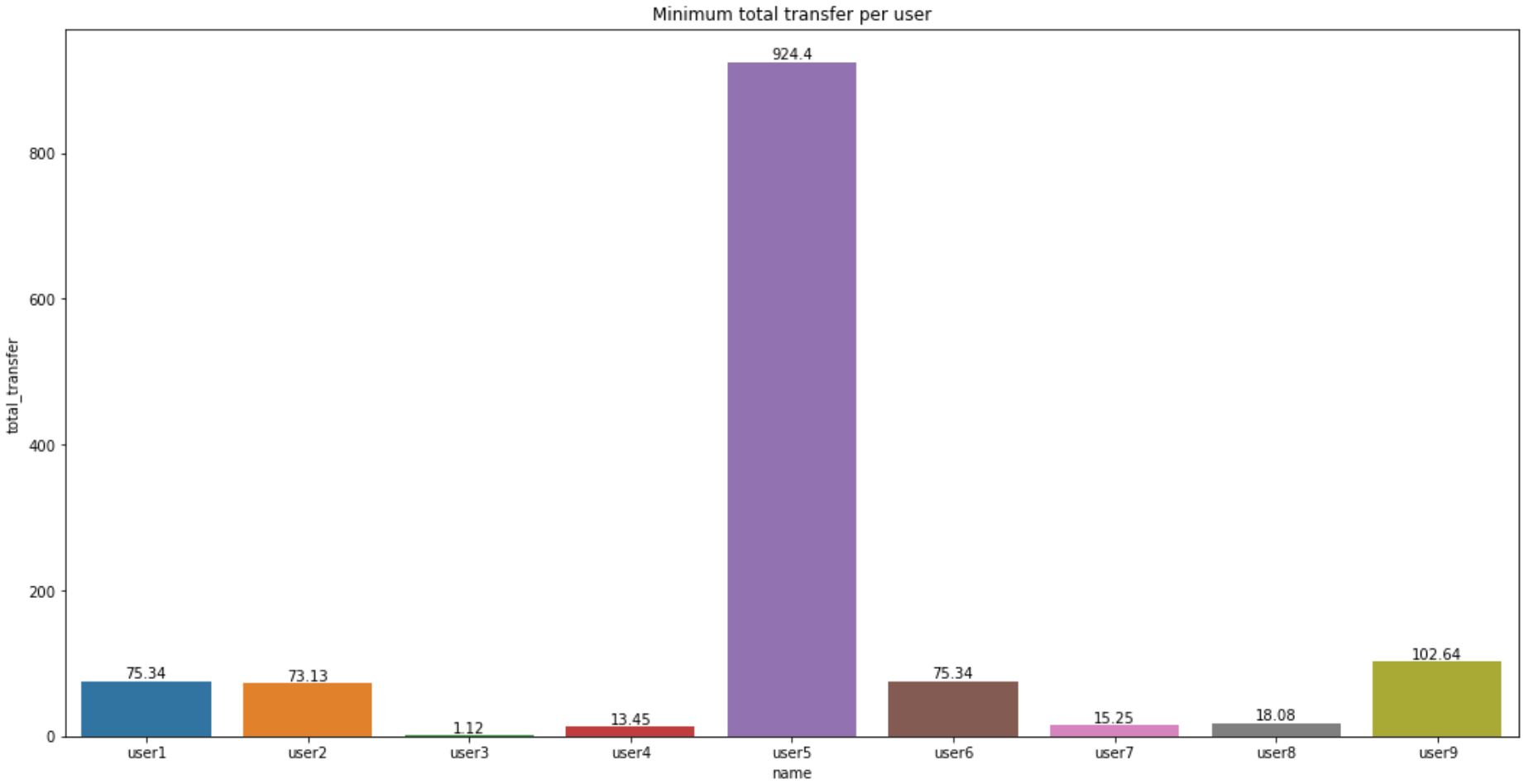
```
The minimum total transfer is: 1.12Kb
The maximum total transfer is: 28552724.48Kb
The average total transfer is: 430437.21Kb
```

==> Minimum total transfer per user

In [42]:
```
print('The minimum total transfer per user:')
internet_usage.groupby('name').total_transfer.min()
```

Out[42]:
```
The minimum total transfer per user:
name
user1     75.34
user2     73.13
user3      1.12
user4     13.45
user5    924.40
user6     75.34
user7     15.25
user8     18.08
user9    102.64
Name: total_transfer, dtype: float64
```

In [43]:
```
plt.figure(figsize=(18, 9))
ax = sns.barplot(x='name', y='total_transfer' , data=internet_usage, ci=None, estimator=np.min)
ax.bar_label(ax.containers[0])
plt.title("Minimum total transfer per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

In [ ]:
```
Referring above, User5 has the highest minimum total transfer with 924.4Kb while User3 has the lowest with 1.12Kb
```

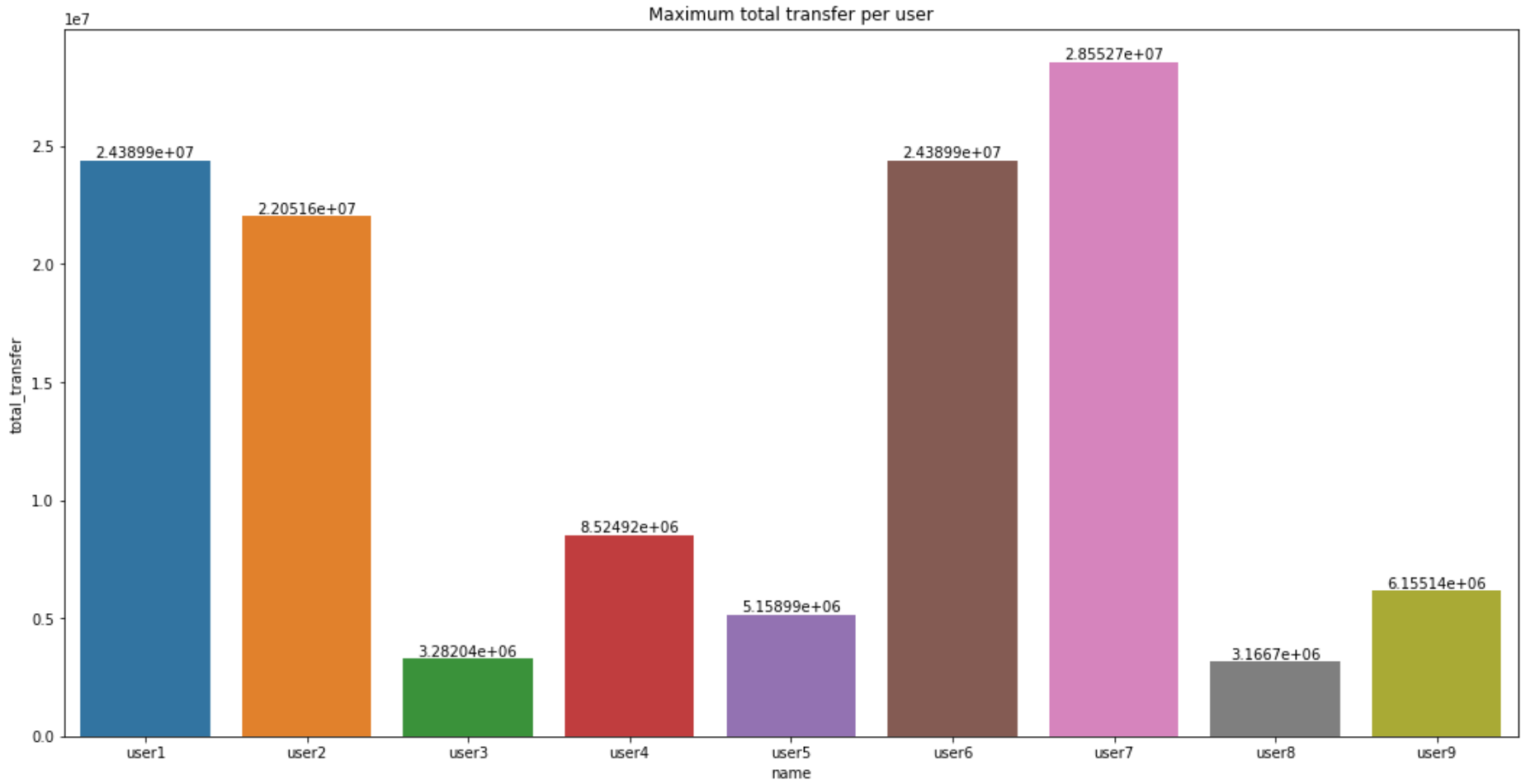
===> Maximum total transfer per user

In [44]:
```
print('The maximum total transfer per user:')
internet_usage.groupby('name').total_transfer.max()
```

```
The maximum total transfer per user:
```

Out[44]:
```
name
user1    24389877.76
user2    22051553.28
user3     3282042.88
user4     8524922.88
user5     5158993.92
user6    24389877.76
user7    28552724.48
user8     3166699.52
user9     6155141.12
Name: total_transfer, dtype: float64
```

In [45]:
```
plt.figure(figsize=(18, 9))
ax = sns.barplot(x='name', y='total_transfer' , data=internet_usage, ci=None, estimator=np.max)
ax.bar_label(ax.containers[0])
plt.title("Maximum total transfer per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

In [ ]:
```
Referring above, User7 has the highest maximum total transfer with 28552724.48Kb while User8 has the lowest with 3166699.52Kb
```

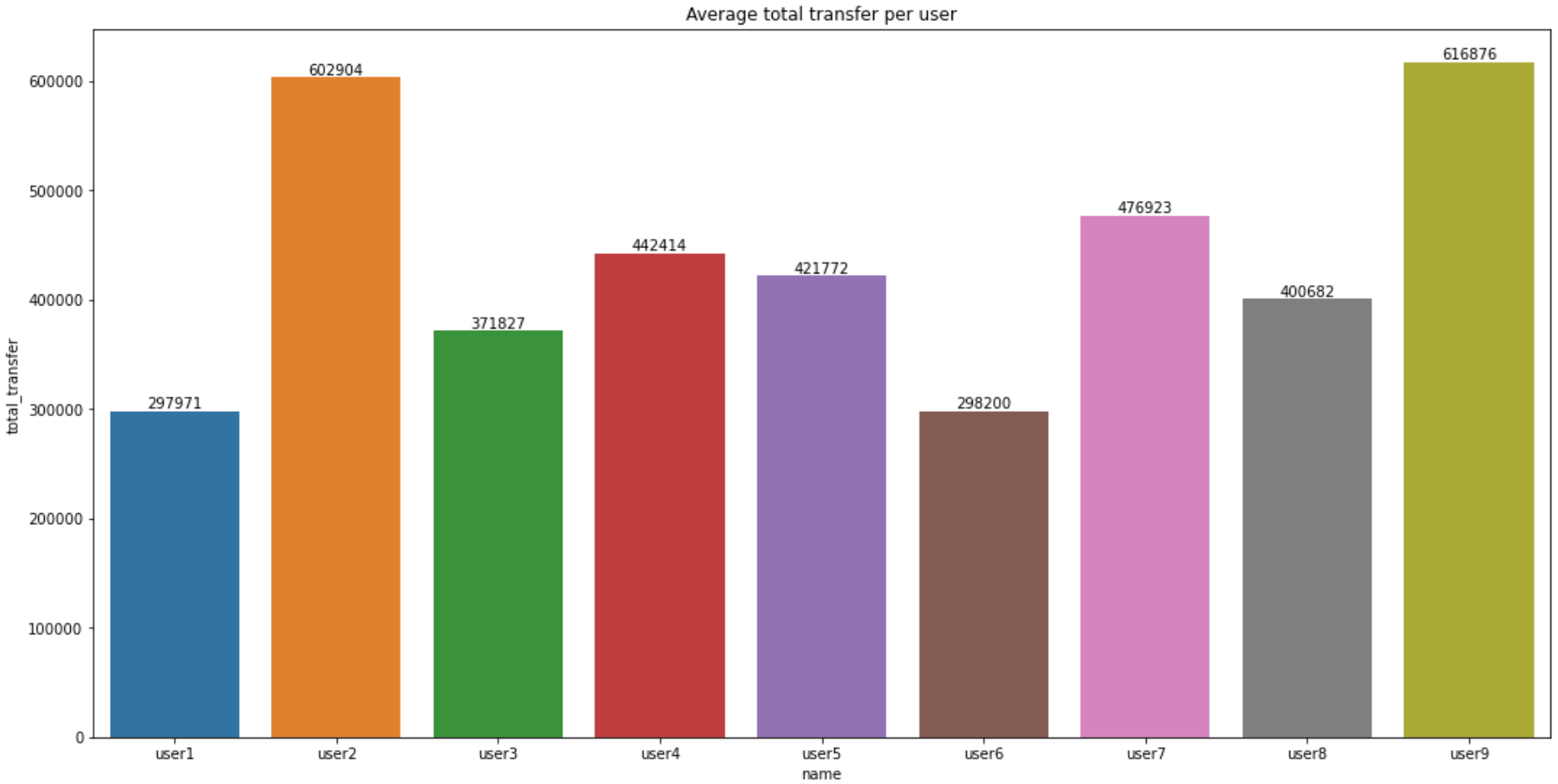
===> Average total transfer per user

In [46]:
```
print('The average total transfer per user:')
round(internet_usage.groupby('name').total_transfer.mean(), 2)
```

```
The average total transfer per user:
```

Out[46]:
```
name
user1    297971.21
user2    602904.19
user3    371826.53
user4    442413.51
user5    421772.04
user6    298199.88
user7    476923.04
user8    400682.28
user9    616875.57
Name: total_transfer, dtype: float64
```

In [47]:
```
plt.figure(figsize=(18, 9))
ax = sns.barplot(x='name', y='total_transfer' , data=internet_usage, ci=None, estimator=np.mean)
ax.bar_label(ax.containers[0])
plt.title("Average total transfer per user")
plt.show()
plt.clf()
```



<Figure size 432x288 with 0 Axes>

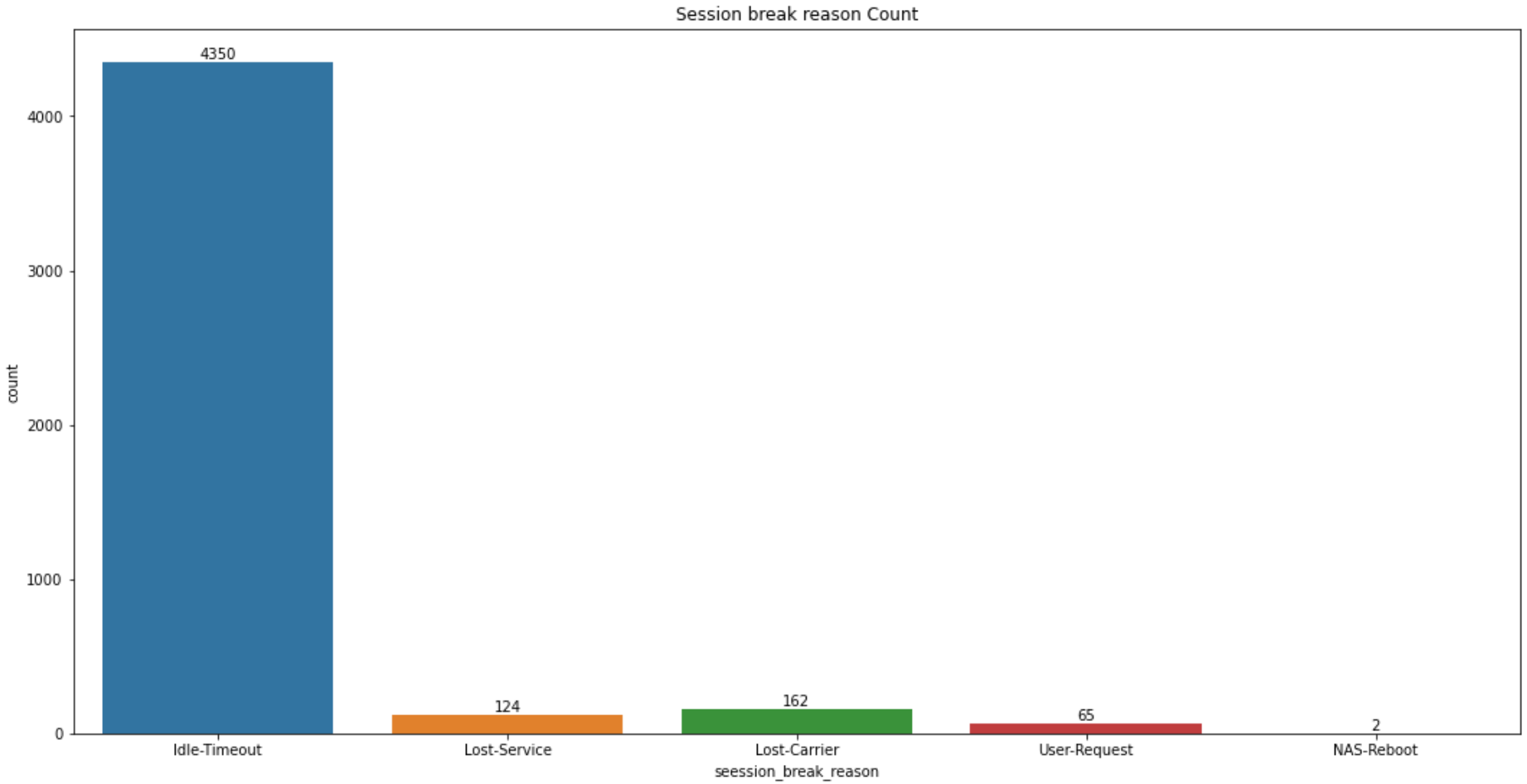
Referring above, User9 has the highest average total transfer with 616875.57Kb while User1 has the lowest with 297971.21Kb

===> Session break reason Count

In [48]:
```
internet_usage.seession_break_reason.value_counts()
```

Out[48]:
```
Idle-Timeout    4350
Lost-Carrier     162
Lost-Service     124
User-Request      65
NAS-Reboot         2
Name: seession_break_reason, dtype: int64
```

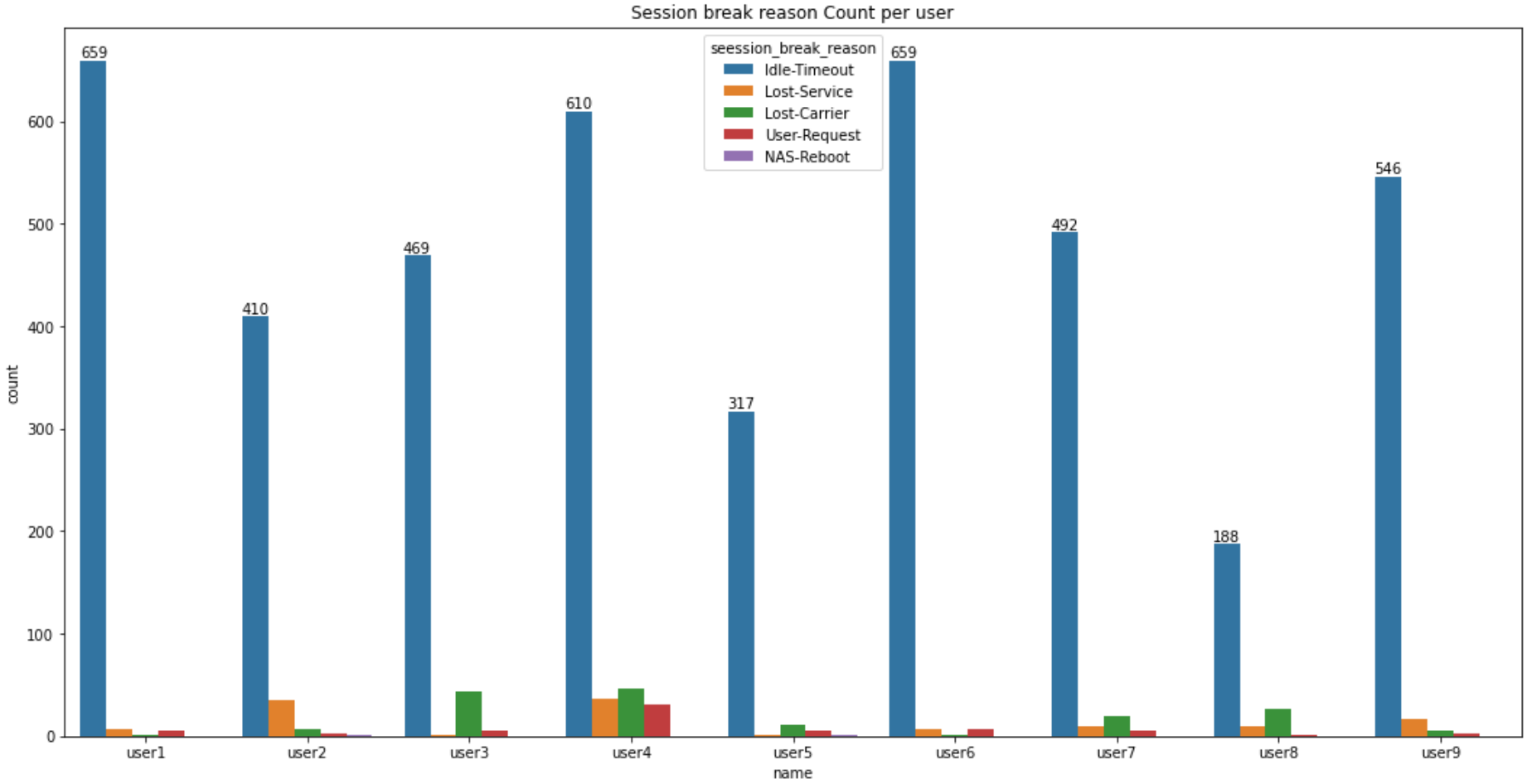
In [49]:
```
plt.figure(figsize=(18, 9))
ax = sns.countplot(x='seession_break_reason' , data=internet_usage)
ax.bar_label(ax.containers[0])
plt.title("Session break reason Count")
plt.show()
plt.clf()
```



```
<Figure size 432x288 with 0 Axes>
```

Referring above, The majority of the session break reasons were from "Idle-Timeout" with 4350 times, while the other reasons have very low occurrences in comparison, with "NAS-Reboot" having the lowest with only 2 occurrences.

In [50]:
```
plt.figure(figsize=(18, 9))
ax = sns.countplot(x='name', hue = 'seession_break_reason' , data=internet_usage)
ax.bar_label(ax.containers[0])
plt.title("Session break reason Count per user")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

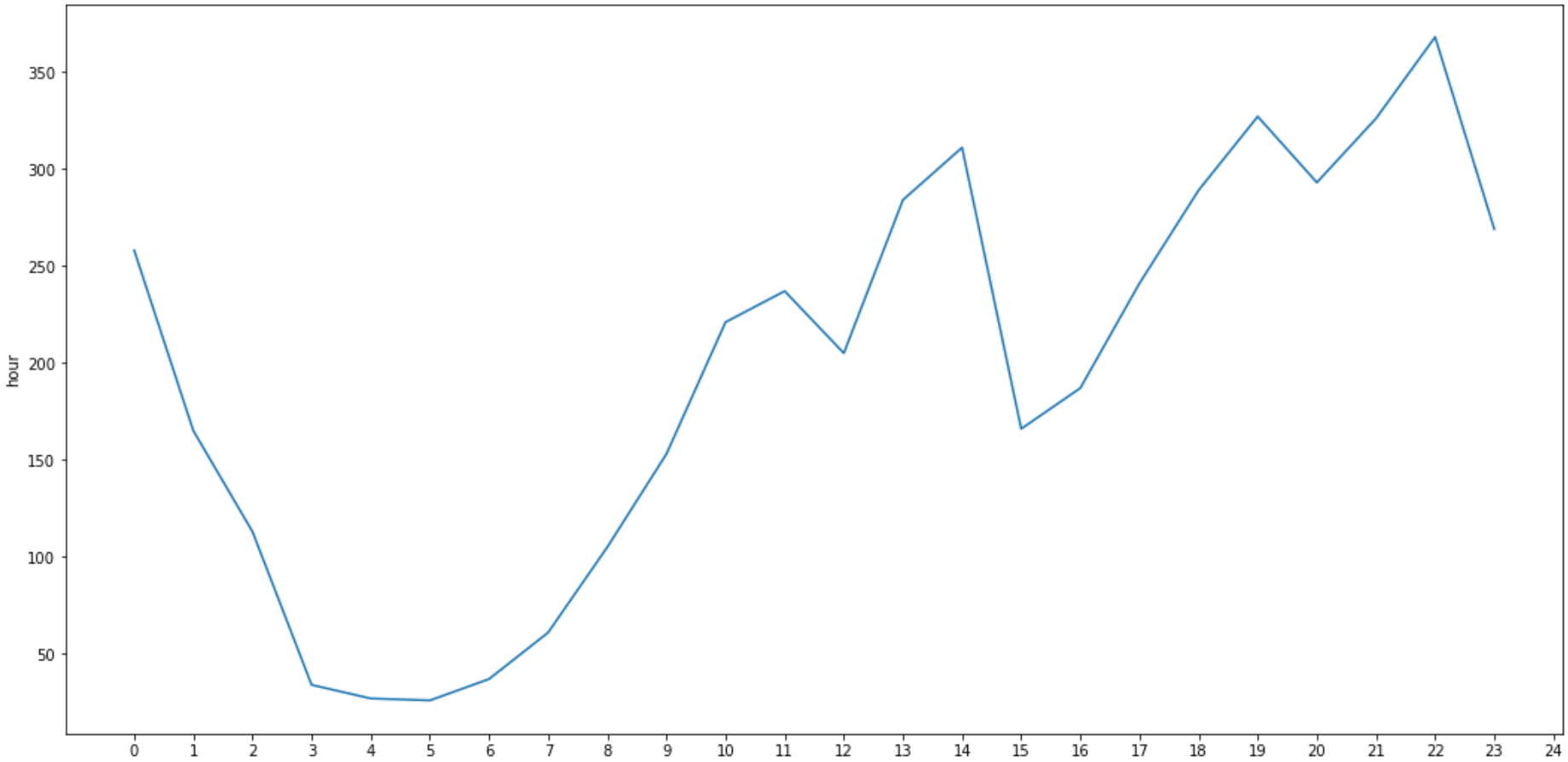
Referring above also per user session break reasons count: it's the same thing, the majority are from "Idle-Timeout" while the other reasons have very low occurrences.

Step3 - Deeper Analysis

Now that finished with the EDA, need to go deeper into our analysis and answer the questions asked earlier

Q: What is the most frequent internet activity time of the day ?

In [51]:
```
internet_usage['hour'] = pd.to_datetime(internet_usage['start_time']).dt.hour
frequent_activity_time_of_day = internet_usage['hour'].value_counts().sort_index()
plt.figure(figsize=(18, 9))
sns.lineplot(data=frequent_activity_time_of_day)
plt.xticks(np.linspace(start=0, stop=24, num=25))
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

The most frequent internet activity time of the day is 22h or at 10pm night.

Q: The most frequent internet activity time of the day is 22h or 10pm

In [52]:
```
base_ip = '48:E7:DA:58:22:E9'
ip_count = 0
for i in range(1, internet_usage.shape[0]):
    if internet_usage.iloc[i]['ip'] != base_ip:
        ip_count +=1
        base_ip = internet_usage.iloc[i]['ip']

print('The IP Adress changed ' + str(ip_count) + ' times')
```

```
The IP Adress changed 2303 times
```

Q: How often the device changed?

In [53]:
```
base_device = 'device1'
device_count = 0
for i in range(1, internet_usage.shape[0]):
    if internet_usage.iloc[i]['device'] != base_device:
        device_count +=1
        base_device = internet_usage.iloc[i]['device']

print('The device changed ' + str(device_count) + ' times')
```

```
The device changed 1223 times
```

In [ ]:
```
Q: What is the average usage per hour , per day and per month ?
```

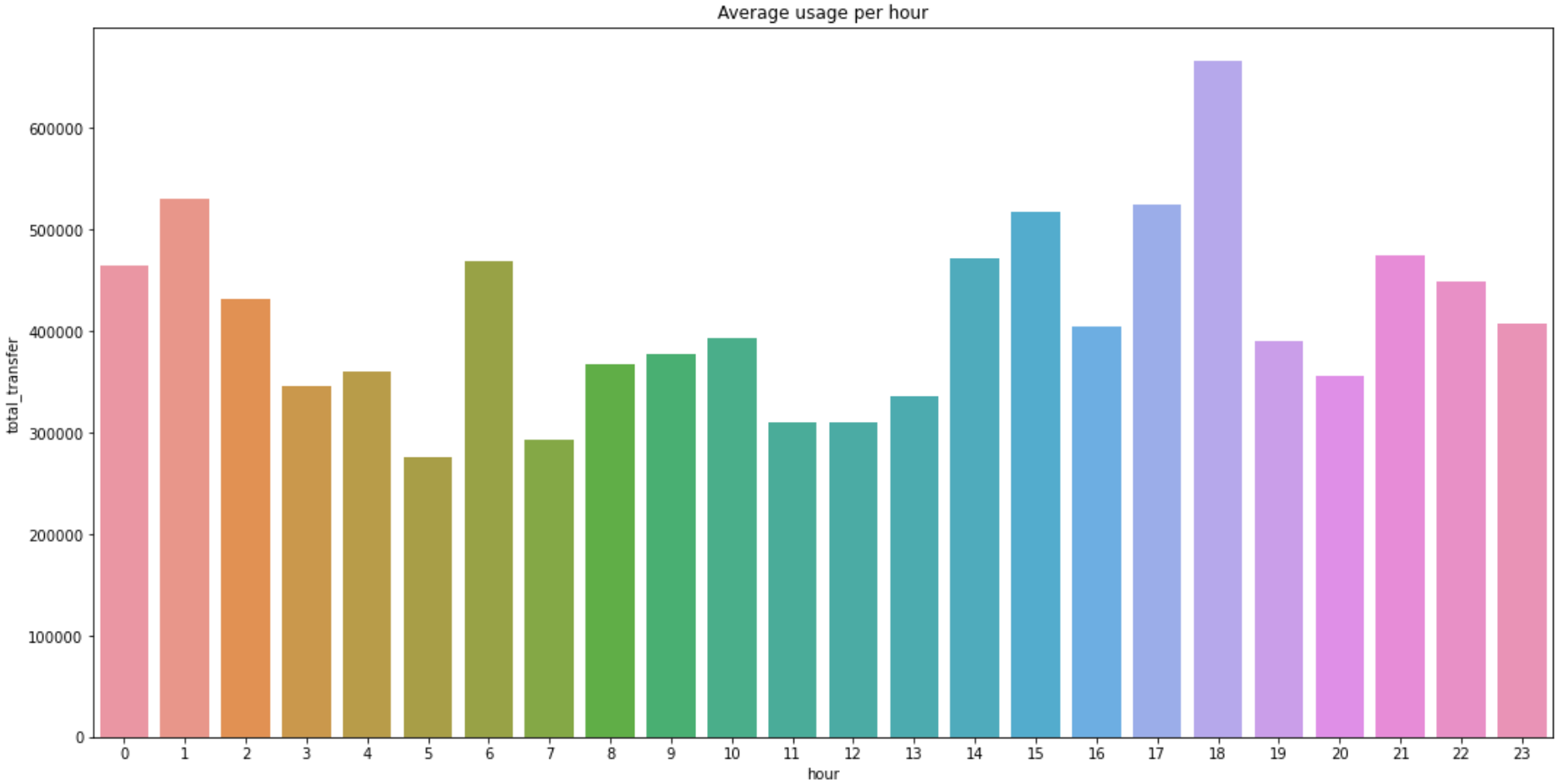
In [54]:
```
internet_usage.reset_index(inplace=True)

internet_usage['day'] = internet_usage['start_time'].dt.day
internet_usage['month'] = internet_usage['start_time'].dt.month

hourly_average = internet_usage.groupby('hour').total_transfer.mean()
print('The Average usage per hour is:\n ' +  str(round(hourly_average, 2)))
```

```
The Average usage per hour is:
 hour
0     464530.44
1     530880.86
2     431576.11
3     345303.34
4     359809.44
5     275960.91
6     468959.59
7     292886.83
8     366681.92
9     377480.64
10    393259.12
11    309492.45
12    310137.98
13    335270.58
14    472403.71
15    517005.11
16    403919.40
17    525423.69
18    666590.76
19    389841.79
20    355862.80
21    474038.34
22    449600.50
23    407785.08
Name: total_transfer, dtype: float64
```

In [55]:
```
plt.figure(figsize=(18, 9))
sns.barplot(x='hour', y='total_transfer' , data=internet_usage, ci=None, estimator=np.mean)
plt.title("Average usage per hour")
plt.show()
plt.clf()
```




```
<Figure size 432x288 with 0 Axes>
```

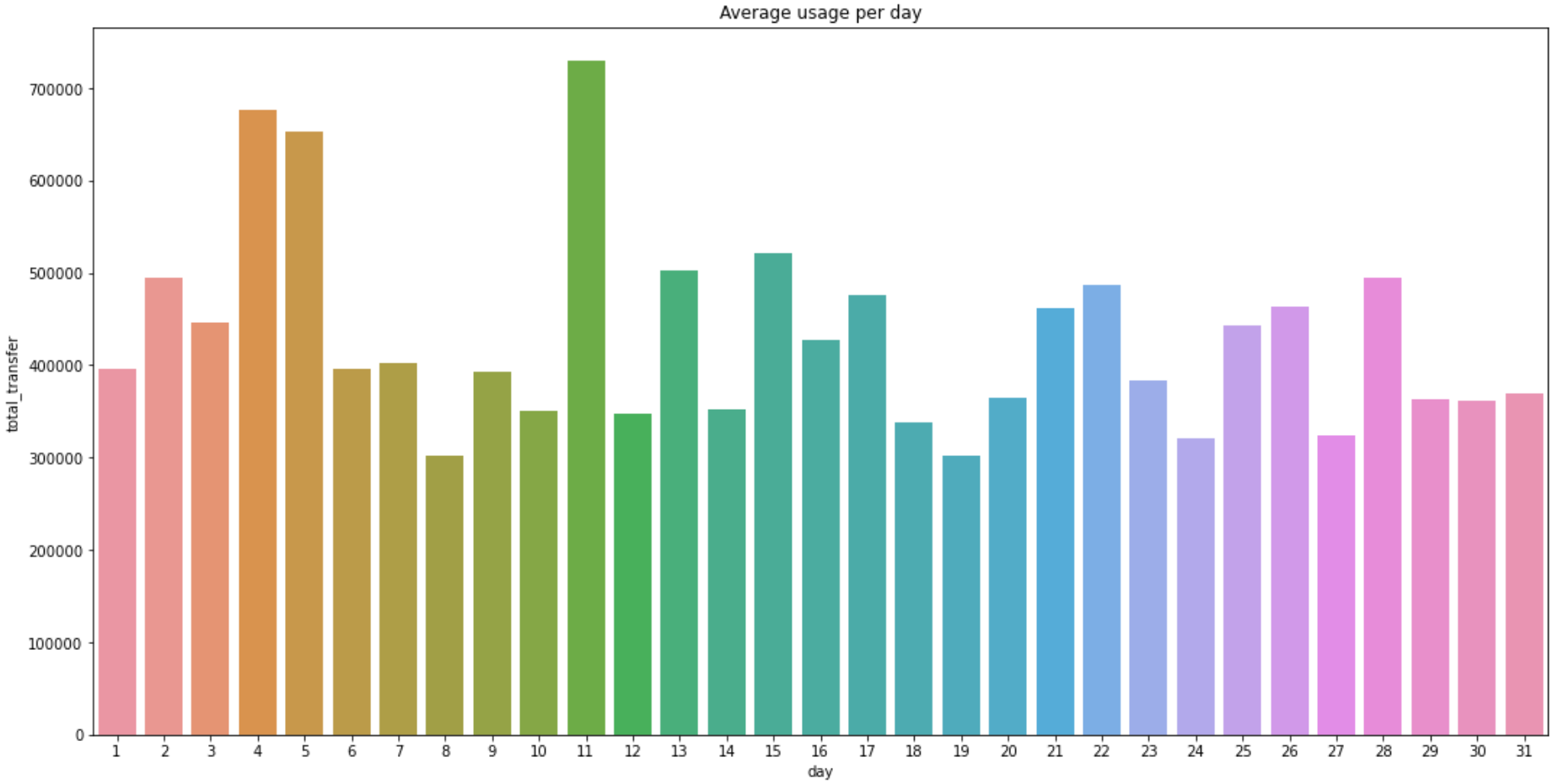
Referring above, can see the average usage per hour

===> Average usage per day

In [56]:
```
daily_average = internet_usage.groupby('day').total_transfer.mean()
print('The Average usage per day is:\n ' +  str(round(daily_average, 2)))
```

```
The Average usage per day is:
 day
1     396705.04
2     494496.48
3     445865.63
4     676332.03
5     652195.66
6     396261.75
7     402259.89
8     301859.57
9     393521.97
10    350665.02
11    729857.65
12    346695.95
13    501906.70
14    352701.10
15    521520.51
16    426719.39
17    475795.71
18    337490.93
19    301941.32
20    365130.12
21    462211.69
22    486595.37
23    383153.93
24    320598.94
25    443689.47
26    463432.02
27    324318.12
28    494576.34
29    363645.61
30    361418.88
31    369118.01
Name: total_transfer, dtype: float64
```

In [57]:
```
plt.figure(figsize=(18, 9))
sns.barplot(x='day', y='total_transfer' , data=internet_usage, ci=None, estimator=np.mean)
plt.title("Average usage per day")
plt.show()
plt.clf()
```



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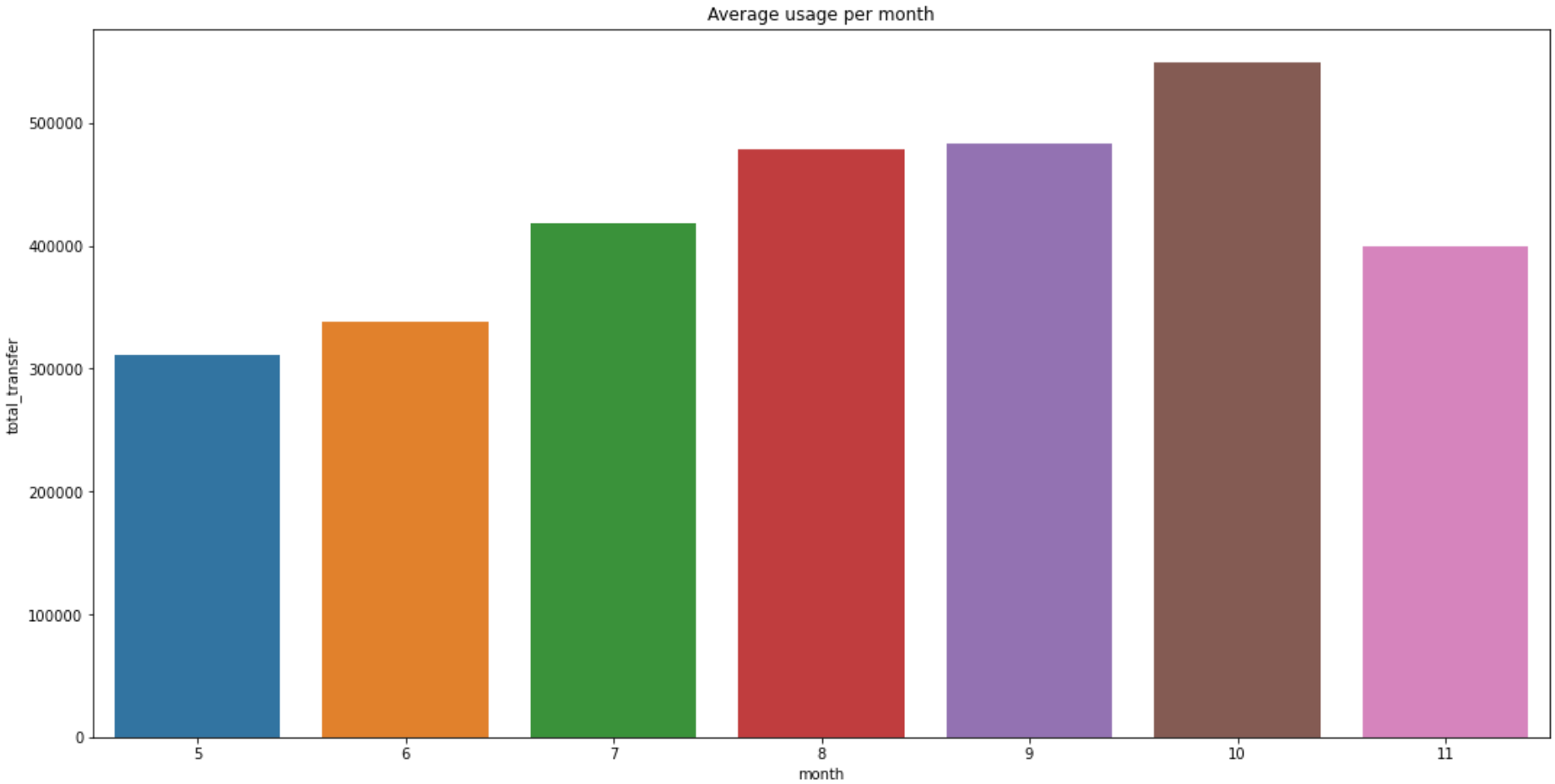
===> Average usage per month

In [58]:
```
monthly_average = internet_usage.groupby('month').total_transfer.mean()
print('The Average usage per month is:\n ' +  str(round(monthly_average, 2)))
```

```
The Average usage per month is:
 month
5     311177.16
6     338418.08
7     418583.99
8     479042.44
9     482955.52
10    549467.63
11    399804.11
Name: total_transfer, dtype: float64
```

In [59]:
```
plt.figure(figsize=(18, 9))
sns.barplot(x='month', y='total_transfer' , data=internet_usage, ci=None, estimator=np.mean)
plt.title("Average usage per month")
plt.show()
plt.clf()
```



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Conclusion

In this project, dataset about the internet usage [in kb] by graduate students at an Indian university. Activities performed are imported the data, cleaned it, analyzed it and answered the questions asked.

The dataset contains 9 users that used 1224 difference devices to connect to the internet while uploading 2841640.0Kb and downloading 27902607.0Kb with a total transfer of 28552724.48Kb during a period of 7 months

The most frequent internet activity time of the day is 22h or upto night 10pm

The IP Adress changed 2303 times while the devices used changed 1223 times

The highest average usage per hour was 666590.76Kb around 18h or evening 6pm. The highest average usage per day was 729857.65Kb around the 11th day of the month, while the highest average usage per month was during the month of October with 549467.63Kb total transfer of data.