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# The Impact of Rainfall on Fiber and Radio Internet Speed

**KEYWORDS**
*Rainfall, fiber, radio, Internet speed, rain*

**ABSTRACT**

Rainfall can have a significant impact on the speed and reliability of fiber and radio internet connections. Heavy rain can cause signal attenuation, which reduces the strength of the signal and can lead to slower internet speeds. Additionally, water can damage outdoor equipment, such as antennas and modems, which can also disrupt internet service. In areas with frequent heavy rainfall, internet service providers may need to take additional steps to protect their equipment and ensure that their service remains reliable. These steps may include installing weather-resistant equipment and implementing redundancy in their networks. Overall, the impact of rainfall on internet speed and reliability is an important consideration for internet service providers, especially in regions where heavy rainfall is common.

## I. INTRODUCTION

With the rapid development of the power system and the concept of "Three Types and Two Grids" proposed by the State Grid Corporation of China, the stability of the power system operation becomes more important [1]. At the moment of steady development in our country, the demand for power loads is also increasing. It is particularly important to use the Internet of Things technology to strengthen the reliability of power grid equipment. The impact of rainfall on wireless and fiber optic internet speed has been a topic of ongoing research in the field of telecommunications. In recent years, advances in technology have led to an increased dependence on high-speed internet access for various aspects of daily life, such as online education, telemedicine, and remote work. As a result, understanding the factors that can affect internet speed and finding ways to mitigate them is crucial for ensuring reliable and consistent internet access [2, 3].

Internet of Things (IoT) networks consist of millions of smart devices and sensors connected to the Internet and collect, analyze, and share environmental data. Data traffic is rapidly growing with increasing the number of smart equipment. The enormous number of IoT devices causes some challenges such as routing and data retrieval over current IP networks. Information-Centric Networking (ICN) is one of the most promising paradigms for routing and innetwork caching in future Internet architectures [4, 5].

It also plays an important role in the analysis and calculation of geological bearing capacity, deformation strength calculation, and description of physical and mechanical geological characteristics of building foundation soils [6]. For example, in a smart city, the sensors of road traffic monitoring are more demanded when the weather is stormy and rainy. However, due to the various high standards of measurement equipment and program control and the strict 978-1-6654-1057-1/22/$31.00 ©2022 IEEE restrictions imposed on the equipment by automatic test machines, this direct method of measurement is both expensive and time consuming [7]. Intelligent algorithm is a computational science method based on people's continuous learning from the whole nature, imitating the structural and physiological habits of other organisms in nature [8]. A state maintenance can effectively improve the monitoring effect of electrical equipment, and can eliminate problems and safety hazards in electrical equipment in a timely manner, which has a very good role in promoting the construction and development of my country's power grid [9]. The Internet of Things is the combination of electronic information technology with people's daily life, and the combination of information and data with communication networks, forming a close connection between things [10].

## II. MATERIALS AND METHODS

### Mendeley

One of the programs that were used during the tasks is the Mendeley application. This is computer software that is used to manage and organize bibliographies and to create bibliographies in various formats.

The program allows to import publications from various sources, such as scientific databases, library catalogs and websites. It is possible to create and share citation lists and store files with publications. Mendeley also makes it easier to work on scientific projects by enabling collaboration with others and managing shared documents.
In short, Mendeley is a tool that helps collect, organize and share scientific information. It has helped get the job done by quickly and automatically organizing bibliographies.

### Excel

Microsoft Excel has often been used to create various types of charts and tables that help present data in a more readable and clear way.

The program allows to compare data. Charts also help to compare data with each other, which can be useful for example in analyzing internet speeds from day to day.

Excel also has a number of analytical tools, such as statistical functions or performers of individual operations, which enable quick and easy data analysis.

### Python script

Code written in Python is used to connect to the meteostat.net API. This makes it easy to generate graphs showing atmospheric conditions at a specific station and a specific period.

The code below (Fig. 1), through the API, creates a graph showing precipitation in December 2022 in Opole needed for internet speed comparison analysis. Also using the matplotlib library, graphs are created showing radio and fiber internet speeds over a month.

```python
from datetime import datetime
import matplotlib.pyplot as plt
import matplotlib
import numpy as np
from meteostat import Daily


start = datetime(2022, 12, 1)
end = datetime(2022, 12, 31)

data = Daily('12530', start, end)
data = data.fetch()

fiber = [315.87, 314.94, 315.64, 314.61, 315.41, 314.58, 315.10, 315.55, 315.32, 314.59, 315.76, 315.26, 3

radio = [25.12, 29.13, 26.43, 31.12, 24.5, 4.37, 9.19, 28.3, 27.3, 29.2, 28.93, 6.54, 30.13, 6.12, 26.32,

days = [1 for i in range(1,32)]

font = {
    'size': 15
}

matplotlib.rc('font', **font)

plt.bar(days, radio)
plt.title('Radio internet speed in December 2022', fontsize=25)
plt.xlabel('Date', fontsize=20)
plt.ylabel('Internet speed in Mbps', fontsize=20)
plt.show()

plt.bar(days, fiber)
plt.title('Fiber internet speed in December 2022', fontsize=25)
plt.xlabel('Date', fontsize=20)
plt.ylabel('Internet speed in Mbps', fontsize=20)
plt.show()

y_pos = np.arange(len(days))
data.plot(y=['prcp'], kind='bar')
plt.title('Precipitation in Opole in December 2022', fontsize=25)
plt.xlabel('Date', fontsize=20)
plt.ylabel('Precipitation in mm', fontsize=20)
plt.xticks(y_pos, days, rotation=360)
plt.show()
```

**Figure 1.** Python script for data visualization

The API found the station in Opole through its ID, which is equal to 12530. Dates are also provided, from which data is then extracted.

It is also possible to generate a graph showing precipitation at a specific time manually, but using the API it is much faster and allows a lot of configurability (such as setting the font size).

It is also possible to generate a graph showing precipitation at a specific time manually, but using the API it is much faster and allows a lot of configurability (such as setting the font size).

## III. OWN DATA

The conducted research yielded a number of results, which are presented in the table below (Table 1).

**Table 1.** Measurement results

| internet speed | | |
|---|---|---|
| date | fiber | radio |
| 1.12.2022 | 315.87 | 25.12 |
| 2.12.2022 | 314.94 | 29.13 |
| 3.12.2022 | 315.64 | 26.43 |
| 4.12.2022 | 314.61 | 31.12 |
| 5.12.2022 | 315.41 | 24.5 |
| 6.12.2022 | 314.58 | 4.37 |
| 7.12.2022 | 315.1 | 9.19 |
| 8.12.2022 | 315.55 | 28.3 |
| 9.12.2022 | 315.32 | 27.3 |
| 10.12.2022 | 314.59 | 29.2 |
| 11.12.2022 | 315.76 | 28.93 |
| 12.12.2022 | 315.26 | 6.54 |
| 13.12.2022 | 315.3 | 30.13 |
| 14.12.2022 | 315.2 | 6.12 |
| 15.12.2022 | 315.61 | 26.32 |
| 16.12.2022 | 314.52 | 2.44 |
| 17.12.2022 | 314.96 | 18.2 |
| 18.12.2022 | 315.25 | 29.33 |
| 19.12.2022 | 314.78 | 30.15 |
| 20.12.2022 | 315.55 | 27.79 |
| 21.12.2022 | 315.37 | 21.87 |
| 22.12.2022 | 314.57 | 22.34 |
| 23.12.2022 | 314.38 | 24.29 |
| 24.12.2022 | 315.16 | 8.14 |
| 25.12.2022 | 314.12 | 23.09 |
| 26.12.2022 | 314.41 | 20.19 |
| 27.12.2022 | 314.22 | 13.43 |
| 28.12.2022 | 315.03 | 23.55 |
| 29.12.2022 | 315.67 | 22.1 |
| 30.12.2022 | 315 | 18.98 |
| 31.12.2022 | 314.31 | 24.44 |

## IV. RESULTS AND DISCUSSION

Fibre optic internet speeds are inherently almost always the same. Deviations are minimal, within the measurement error of the internet connection speed tester. Fibre optic internet providers deliver speeds very close to those agreed in the contract or sometimes even higher. This is also confirmed by the measurement results shown in Figure 2.

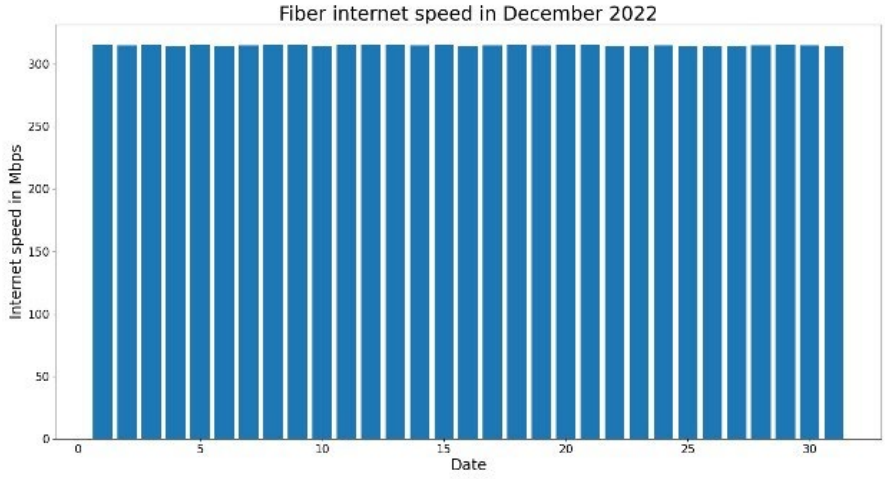


**Figure 2.** The graph shows fibre internet speeds on a given day in the month of December 2022

Deviations in sending and receiving speeds are marginal, and the only problems with the internet in the case of fibre optic technology are on the part of the internet provider (software errors in internet equipment or mechanical interruption of the connection).

Radio internet speeds are by their very nature, variable. Deviations are dependent on many factors in cluding weather conditions, the quality of the connection or external factors such as another device with similar performance characteristics. The results obtained with the Internet connection speed tester vary (Fig. 3). The highest variation in internet connection speed was detected in the case of rain. On a day with snowfall, speed drops occurred, but were not as significant as in the case of rainfall.

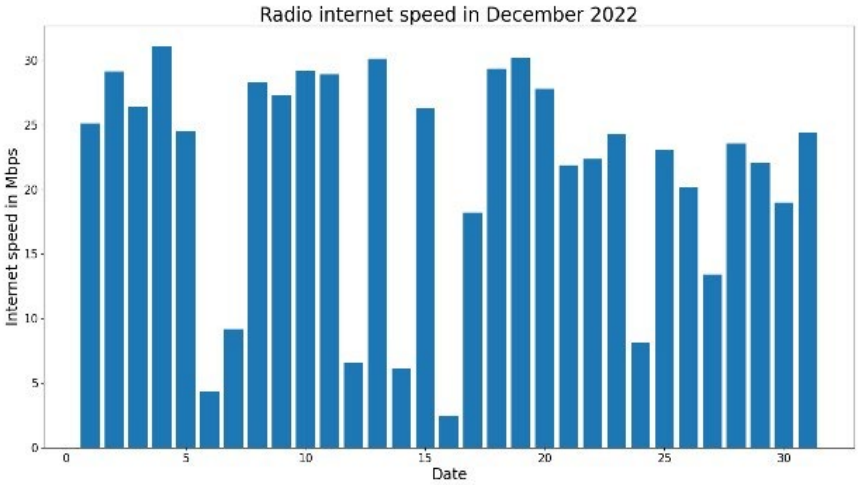


**Figure 3.** The graph shows radio internet speeds on a given day in the month of December 2022

December was low in rainfall in Opole. Rainfall occurred at the beginning of the month, followed by snowfall. There were only 21 days with precipitation. In the graphs showing radio internet speeds, one can see a correlation between the intensity of precipitation and drops in internet speeds (Fig. 4).

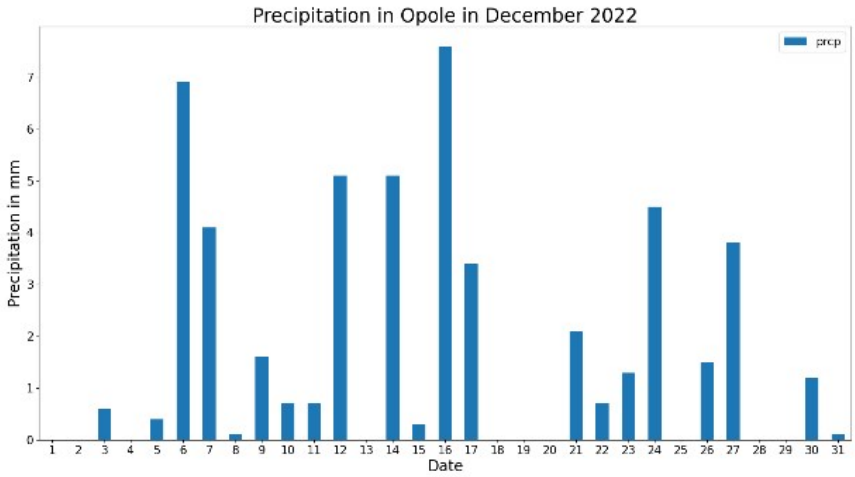


**Figure 4.** The graph shows the abundance of rainfall on a given day in the month of December 2022

The graph shows the result of an internet speed measurement performed with a bandwidth testing programme (Fig. 5). The result shows that on 6.12.2022 the transfer of 314.5 Mbps was received, which is higher than the contractual provision with the Internet provider, which guarantees a transfer of 300 Mbps.

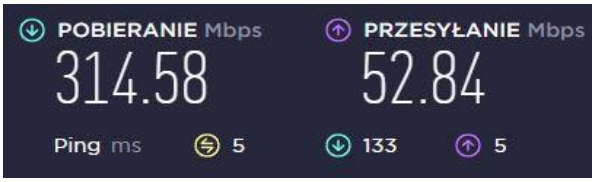


**Figure 5.** The screenshot shows the speed of fibre internet on 06.12.2022

The graph shows the result of a radio internet speed measurement performed with a bandwidth testing programme (Fig. 6). The result shows that a transfer of 4.37 Mbps was received on 6.12.2022. The result obtained is clearly lower than the speeds of the other days on which measurements were conducted. This is due to the fact that there was rainfall on this day.

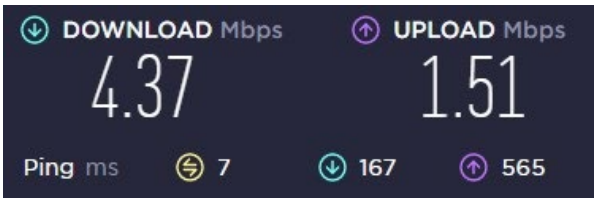


**Figure 6.** The screenshot shows the speed of the radio internet on 6.12.2022

The graph shows the result of an internet speed measurement performed with a bandwidth testing programme (Fig. 7). The result shows that a transfer volume of 314.52 Mbps download and 53,46 of upload was obtained on 14.12.2022. There was quite heavy rainfall on this day and the measurement was taken at a time when the rain was falling heavily.

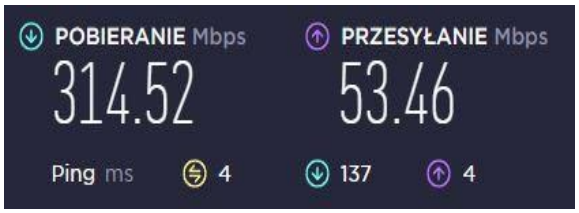


**Figure 7.** The screenshot shows the speed of fibre internet on 14.12.2022

The graph shows the result of a radio internet speed measurement performed with a bandwidth testing programme (Fig. 8.). The result shows that a transfer of 2.44 Mbps download and 4.78 Mbps upload was received on 14.12.2022. The result obtained is the lowest measurement detected. This is due to the fact that heavy rainfall took place that day.

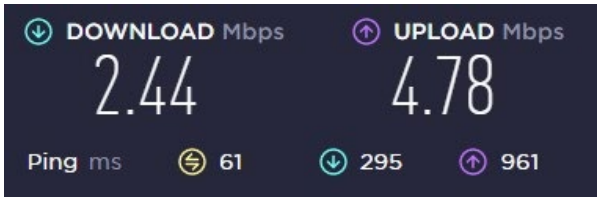


**Figure 8.** The screenshot shows the speed of radio internet on 14.12.2022

The graph shows the result of an internet speed measurement performed with a bandwidth testing programme (Fig. 9). The result shows that on 29.12.2022, a transfer size of 315.67 Mbps was received. Snowfall occurred on this day. As you can see, in this case the transfer speed of the fibre optic network did not deteriorate, in fact the result obtained has the highest transfer result.

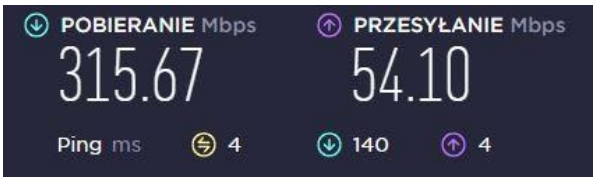


**Figure 9.** The screenshot shows the speed of fibre internet on 29.12.2022

The graph shows the result of an internet speed measurement made with a bandwidth test programme (Fig. 10). The result shows that a transfer of 22.10 Mbps download and 0.20 Mbps upload was received on 29.12.2022. There was snowfall on this day. As can be seen, in this case the transfer speed of the radio network did deteriorate significantly, but it is a lower decrease as for the data transfer recorded on rainy days.

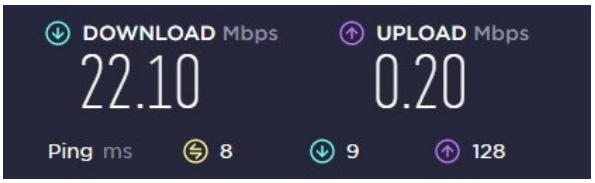


**Figure 10.** The screenshot shows the speed of radio internet on 29.12.2022

The graph shows the result of an internet speed measurement made with a bandwidth testing programme (Fig. 11). The result shows that a transfer volume of 315.30 Mbps was obtained on 13.12.2022. The result obtained, like the previous ones, is higher than the speed that the service provider should provide us with according to the contract.

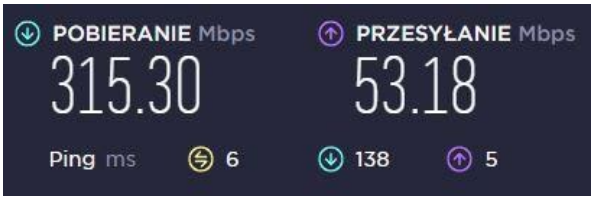


**Figure 11.** The screenshot shows the speed of fibre internet on 13.12.2022

The graph shows the result of an internet speed measurement made with a bandwidth test programme (Fig. 12). The result shows that a transfer of 30.13 Mbps download and 12.28 Mbps upload was received on 13.12.2022. No precipitation occurred on this day. As can be seen, in this case the transfer speed of the radio network did not deteriorate.

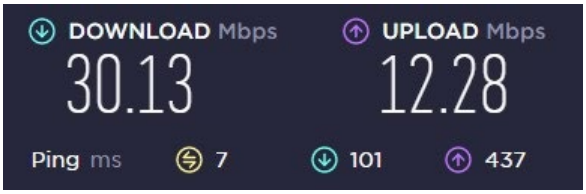


**Figure 12.** The screenshot shows the speed of radio internet on 13.12.2022

## CONCLUSION

The survey was conducted through December 2022. The speed of radio and fiber Internet was studied and compared, and how rainfall affects it. The speed results were checked on speedtest.net. On days when it is not raining, radio internet speeds are not as significant.

The study revealed that internet transmitted by radio has a high variability in speed during rainfall. During raining days, the speed of radio internet was much lower than on days when it did not rain. Unlike radio internet, fiber internet showed no significant variation in speed regardless of weather conditions. Deviations of the readings were marginal or within the measurement error. The conclusion of the study is that fiber-optic internet is more reliable and stable, especially in more difficult weather conditions such as rain or snow.

The results of the study may be important for Internet network operators, as it allows them to adapt their services to different weather conditions. They can also use it in planning and building network infrastructure to provide better service to their customers. In addition to ISPs, those interested in purchasing a particular Internet package can benefit from the study. They can base their decision on the survey. As a result, they will choose the right technology to meet their requirements.

The conclusions of the survey also suggest that fiberoptic technology may become more common in the future, as it is more weatherproof and also offers significantly higher bandwidths compared to radio technology. It is worth noticing that the study was conducted for only one month, so further investigation is needed to confirm these results.

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