

Classification of Home Network Users to Improve User Experience

 Project for WIN « Wireless Intelligent Networks » students

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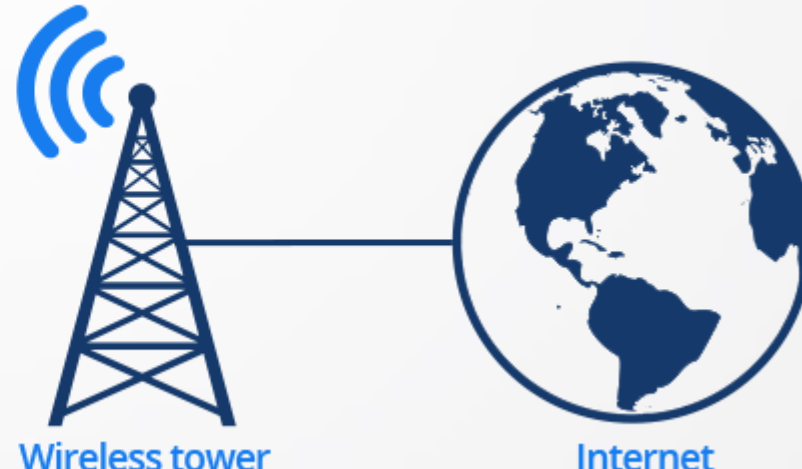
January 2023



Project Context



Home BroadBand

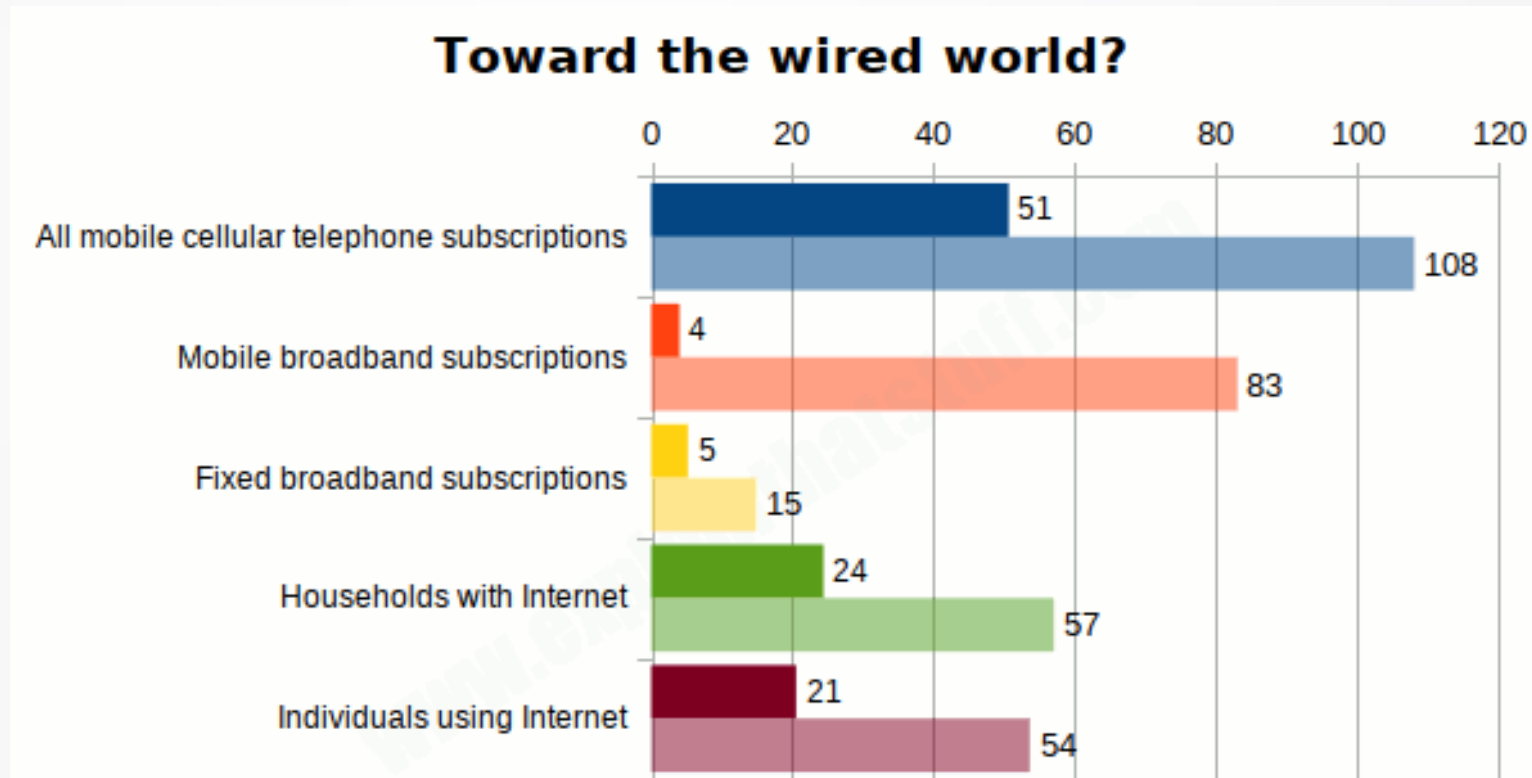




Project Context



Home BroadBand



Dark bars = 2007; lighter bars = 2019. Source: ITU-T, June 2020.

<https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>



Project Context



Home BroadBand and Mobile Cellular UE

- ❖ Network Saturation
- ❖ Lack of resources
- ❖ Bad Communication quality
- ❖ Bad User Experience

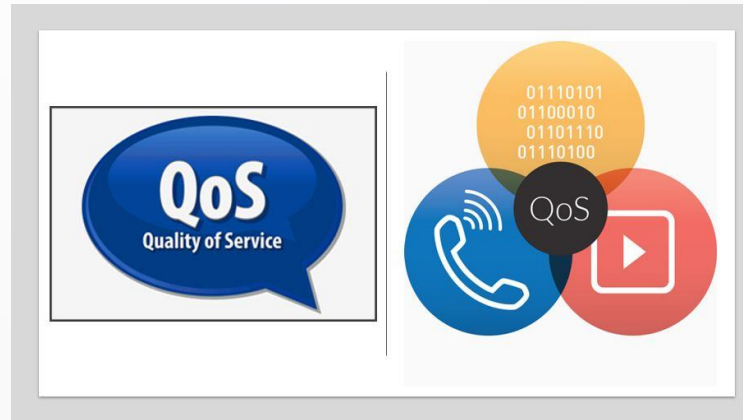




Project Context



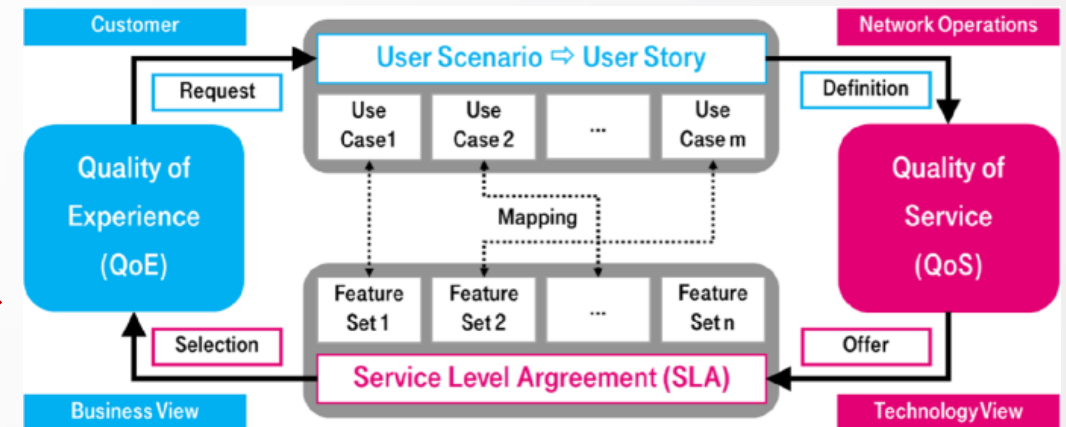
- User experience and broadband quality have become the key factors determining market competitiveness. How to find network quality problems and improve user experience in time has become the focus of increasing attention of operators.





Objective

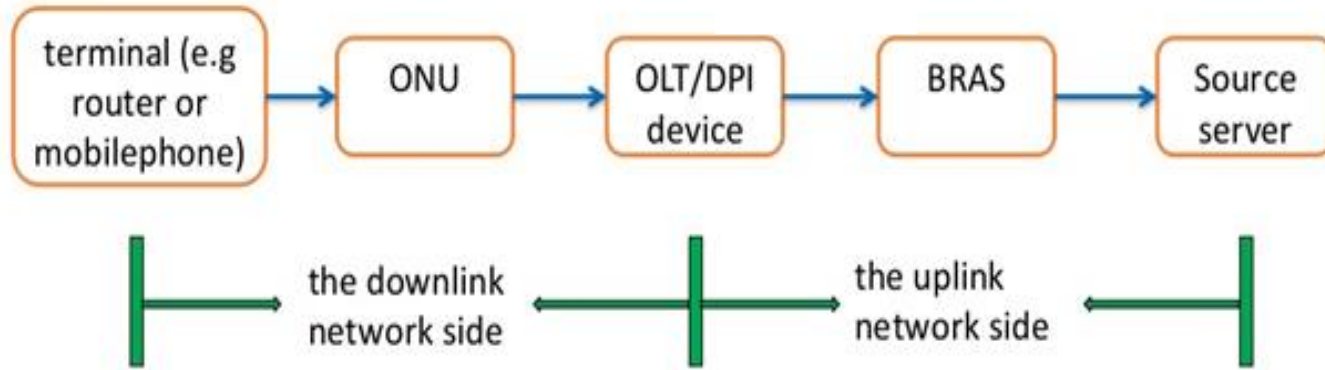
- Classify each user and accurately distinguish between users with bad experience and users with good experience using ML/DL methods.



Operators try to detect problems with the network's quality and improve the user's experience as fast as possible.



DataSet ZTE



90% of problems

10% of problems

An **ONU** (optical network unit) is located outside the home. An ONU converts optical signals to electrical signals via a fiber cable. An ONU organizes and optimizes different types of data coming from customers to efficiently send it upstream to the **OLT** (Optical Line Terminal) located at an ISP's central hub and the **DPI** (Deep Packet Inspection) device,

The **BRAS** (Broadband remote access server) is a broadband network gateway and is the aggregation point for the subscriber traffic. It provides aggregation capabilities. In addition to aggregation, it is also a policy management and QoS enforcement point for IP QoS in the access network.

Description

- ❖ Out of 15+ indicators, 8 were determined as the key, by the problem providers,
- ❖ Data obtained from real-world DPI devices were provided,
- ❖ Each user had a separate CSV with time-series data.

- ❖ 150 training, 50 validation, and 50 Test UGE users,



- ❖ 150 training, 50 validation, and 50 Test UBE users,





DataSet



► The specific physical meanings of the indicators are as follows:

- The provided dataset contains 8 key indicators, which are defined as indicator 1 to indicator 8.
- The indicators are obtained from the three-way handshake process and the data transmission process after the handshake is successful.

Indicator 1	In the first step of the three-way handshake, the time interval between the syn ack packet and the ack packet;
Indicator 2	In the second step of the three-way handshake, the time interval between the syn ack packet and the ack packet;
Indicator 3	The time interval between the ack packet and the first payload packet in the three-way handshake;
Indicator 4	The response delay of the first packet with payload after the establishment of TCP for multiple flows in the session;
Indicator 5	In TCP transmission, the actual delay of transmission from the DPI position to the user terminal;
Indicator 6	In TCP transmission, the transmission delay from the DPI position to the website;
Indicator 7	In TCP transmission, the percentage of downlink retransmitted packets in the current session;
Indicator 8	In TCP transmission, the percentage of upstream retransmission packets of the current session



Evaluation criteria



- ▶ Students must use the provided data set to **train** a machine learning algorithm.
- ▶ The output of the ML algorithm should be able to **predict** the performance obtained in a **new** network deployment.
- ▶ The choice of the **ML approach** is decided by each group.
- ▶ The **test dataset** will be provided to the students to evaluate the performance of the proposed algorithms.
- ▶ Different **evaluation criteria** should be proposed and used.



Thank you

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